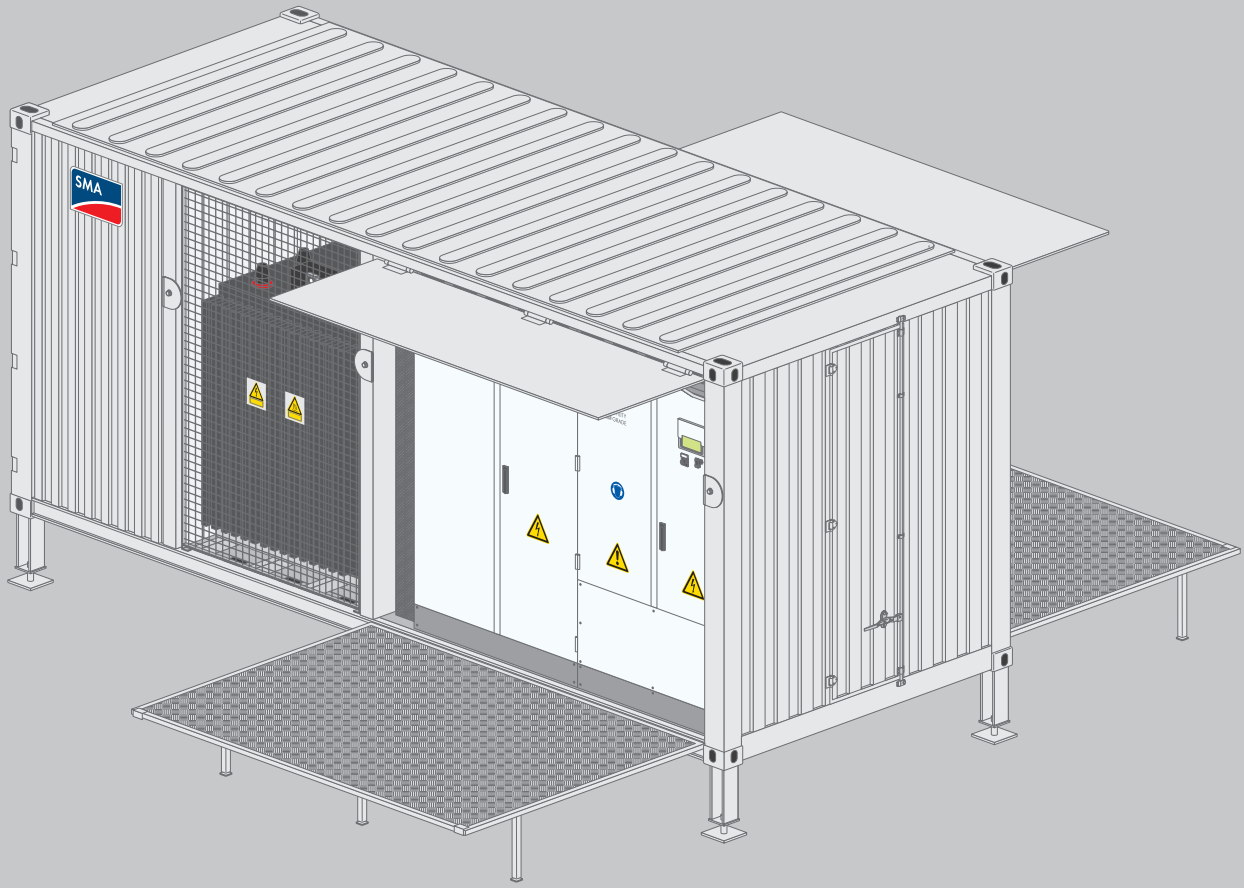
System Manual

MEDIUM VOLTAGE POWER STATION 500SC / 630SC / 800SC / 900SC / 1000-1SC / 1000-2SC / 1250SC / 1600SC / 1800SC / 2000SC



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1 Information on this Document

1.1 Validity

This document is valid for the following device types of the MV Power Station with the inverters of the series Sunny Central 500CP XT to 1000CP XT:

- Medium Voltage Power Station 500SC (MVPS 500SC 21)
- Medium Voltage Power Station 630SC (MVPS 630SC 21)
- Medium Voltage Power Station 800SC (MVPS 800SC 21)
- Medium Voltage Power Station 900SC (MVPS 900SC 21)
- Medium Voltage Power Station 1000-1SC (MVPS 1000SC 21)
- Medium Voltage Power Station 1000-2SC (MVPS 1000-2SC 21)
- Medium Voltage Power Station 1250SC (MVPS 1250SC 21)
- Medium Voltage Power Station 1600SC (MVPS 1600SC 21)
- Medium Voltage Power Station 1800SC (MVPS 1800SC 21)
- Medium Voltage Power Station 2000SC (MVPS 2000SC 21)

The production version is indicated on the type label.

Illustrations in this document are reduced to the essential and may deviate from the real product.

1.2 Target Group

The tasks described in this document must only be performed by qualified persons. Qualified persons must have the following skills:

- Knowledge of how the product works and is operated
- Training in how to deal with the dangers and risks associated with installing and using electrical devices and systems
- Training in the installation and commissioning of electrical devices and systems
- Knowledge of all applicable standards and directives
- Knowledge of and adherence to this manual and all safety precautions

1.3 Additional Information

Links to additional information can be found at www.SMA-Solar.com.

1.4 Symbols

Symbol	Explanation
⚠ DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury
⚠ WARNING	Indicates a hazardous situation which, if not avoided, can result in death or serious injury
⚠ CAUTION	Indicates a hazardous situation which, if not avoided, can result in minor or moderate injury
NOTICE	Indicates a situation which, if not avoided, can result in property damage
i	Information that is important for a specific topic or goal, but is not safety-relevant

Symbol	Explanation
☐	Indicates a requirement for meeting a specific goal
☑	Desired result
✖	A problem that might occur

1.5 Typographies

Typographies	Use	Example
bold	• Display messages • Elements on a user interface • Terminals • Slots • Elements to be selected • Elements to be entered	• Set parameter **WGra** to **0.2**.
>	• Connects several elements to be selected	• Select **PV system > Detect**.
[**Button/Key**]	• Button or key to be selected or pressed	• Select [**Start detection**].

1.6 Nomenclature

The products installed on the Medium Voltage Power Station, such as the inverter or the MV transformer, are referred to as "devices".

Complete designation	Designation in this document
Medium Voltage Power Station	MV Power Station
Sunny Central Communication Controller	SC-COM or communication unit
Medium-voltage transformer	MV transformer

2 Safety

2.1 Intended Use

The MV Power Station is a complete system for PV power plants. All devices required to convert the direct current generated by the PV modules into alternating current and to feed this current into the medium-voltage grid are located in the MV Power Station.

Operation of the MV Power Station is only permitted providing that the maximum permissible DC input voltage, AC output voltage and the required ambient conditions are adhered to. The maximum permissible DC input voltage, AC output voltage and the required ambient conditions are subject to the respective configuration of the MV Power Station. Ensure that the ambient conditions and the maximum permissible voltage are complied with prior to commissioning the MV Power Station.

It is only permitted to use the product in a PV power plant which is designed as a closed electrical operating area as per IEC 61936-1.

The specified safety clearances must be observed.

Do not deactivate or modify settings that affect grid management services without first obtaining approval from the grid operator.

The product is designed for outdoor use only.

Use this product only in accordance with the information provided in the enclosed documentation and with the locally applicable standards and directives. Any other application may cause personal injury or property damage.

Alterations to the product, e.g. changes or modifications, are only permitted with the express written permission of SMA Solar Technology AG. Unauthorized alterations will void guarantee and warranty claims and in most cases terminate the operating license. SMA Solar Technology AG shall not be held liable for any damage caused by such changes.

Any use of the product other than that described in the Intended Use section does not qualify as appropriate.

The enclosed documentation is an integral part of this product. Keep the documentation in a convenient place for future reference and observe all instructions contained therein.

Only persons fulfilling all of the skills for the target group are permitted to work on or with the product.

All work on the product must only be performed using appropriate tools and in compliance with the ESD protection regulations.

Suitable personal protective equipment is to be worn by all persons working on or with the product.

Unauthorized persons must not operate the product and must be kept at a safe distance from the product.

The service platforms and the protection roofs for the inverter compartment and transformer compartment must be open during operation. All other doors and covers must be closed during operation.

The product must not be opened when it is raining or when humidity exceeds 95%.

The product must not be operated with any technical defects.

The type label must remain permanently attached to the product.

2.2 Safety Information

This section contains safety information that must be observed at all times when working on or with the product. To prevent personal injury or property damage and to ensure long-term operation of the product, read this section carefully and observe all safety information at all times.

⚠ DANGER

Danger to life from electric shock due to live voltage

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Wear suitable personal protective equipment for all work on the product.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 7.4, page 102).

⚠ DANGER

Danger to life from electric shock due to live DC cables

DC cables connected to PV modules that are exposed to sunlight carry live voltage. Touching live cables results in death or serious injury due to electric shock.

- Prior to connecting the DC cables, ensure that the DC cables are voltage-free.
- Wear suitable personal protective equipment for all work on the device.

⚠ DANGER

Danger to life from electric shock due to ground fault

If a ground fault has occurred, parts of the PV power plant that are supposedly grounded may in fact be live. Touching incorrectly grounded parts of the PV power plant results in death or serious injuries from electric shock.

- Before working on the PV power plant, ensure that no ground fault is present.
- Wear suitable personal protective equipment for all work on the device.

⚠ DANGER

Danger to life from electric shock due to damaged product

Operating a damaged product can lead to hazardous situations that result in death or serious injuries due to electric shock.

- Only operate the product when it is in a flawless technical condition and safe to operate.
- Check the product regularly for visible damage.
- Make sure that all external safety equipment is freely accessible at all times.
- Make sure that all safety equipment is in good working order.
- Wear suitable personal protective equipment for all work on the product.

⚠ DANGER

Danger to life from electric shock even if the inverter is disconnected on the AC and DC sides

The precharge unit of the order option "Q at Night" will carry live voltage even if the AC contactor and the DC switchgear are open. Touching live components results in death or serious injury due to electric shock.

- Do not touch any live components.
- Switch off the inverter.
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that no voltage is present.
- Do not remove protective covers.
- Observe the warning messages.
- Wear suitable personal protective equipment for all work on the product.

⚠ DANGER

Danger to life from electric shock from improperly operating the tap changer of the MV transformer.

Operating the tap changer of the MV transformer while energized will create a short circuit in the MV transformer. The resulting voltages will lead to death or serious injury.

- Only operate the tap changer when the MV transformer is dead.
- Ensure the MV transformer is dead before performing any work or making any adjustments.
- All work and adjustments on the MV transformer must be performed by a duly authorized person.
- Wear suitable protective equipment for all work.

⚠ WARNING

Danger to life from electric shock if the product is not locked

If the product is not locked, unauthorized persons will have access to live components carrying lethal voltages. Touching live components can result in death or serious injury due to electric shock.

- Always close and lock the product.
- Remove the keys.
- Store the keys in a safe place.
- Ensure that no unauthorized persons have access to the closed electrical operating area.

⚠ WARNING

Risk of fire due to failure to observe torque specifications on live bolted connections

Failure to follow the specified torques reduces the ampacity of live bolted connections so that the contact resistances increase. This can cause components to overheat and catch fire.

- Ensure that live bolted connections are always tightened with the exact torque specified in this document.
- When working on the device, use suitable tools only.
- Avoid repeated tightening of live bolted connections as this may result in inadmissibly high torques.

⚠ WARNING

Danger to life from electric shock when entering the PV field

Ground-fault monitoring does not provide protection from personal injury. PV modules which are grounded with ground-fault monitoring discharge voltage to ground. Entering the PV field can result in lethal electric shocks.

- Ensure that the insulation resistance of the PV field exceeds the minimum value. The minimum value of the insulation resistance is: 1 kΩ.
- Before entering the PV field, switch the PV modules to insulated operation.
- Configure the PV power plant as a closed electrical operating area.

⚠ WARNING

Danger to life due to arc fault caused by fault in the medium-voltage switchgear

If there is a fault in the medium-voltage switchgear, arc faults may occur during operation of the product which can result in death or serious injuries. If arc faults occur in the medium-voltage switchgear, the pressure evacuates under the compartment of the medium-voltage switchgear.

- Only perform work on the medium-voltage switchgear when it is in a voltage-free state.
- Only perform switching operations on the medium-voltage switchgear from the service platform.
- Do not touch or access the roof of the medium-voltage switchgear when medium voltage is connected.
- When switching operations are performed, all persons that are not on the service platform have to keep a safe distance from the product.
- All work and switching operations on the medium-voltage switchgear must only be performed by qualified persons wearing adequate personal protective equipment.

⚠ CAUTION

Risk of burns due to hot components

Some components of the product can get very hot during operation. Touching these components can cause burns.

- Observe the warnings on all components.
- During operation, do not touch any components marked with such warnings.
- After switching off the product, wait until any hot components have cooled down sufficiently.
- Wear suitable personal protective equipment for all work on the product.

⚠ CAUTION

Danger of falling from service platforms

Icy, moist or sand-covered service platforms may be slippery. Service personnel can be injured by slipping or falling from service platforms.

- Wear suitable personal protective equipment for all work on the product.
- Before stepping onto the service platform, ensure that there is no layer of snow, ice, sand or moisture on the platform.
- Do not keep any objects near or on the service platforms.

⚠ CAUTION

Risk of injury from collapse of roof and protection roofs under excessive snow load

If the maximum permissible snow load is exceeded, the roof and the protection roofs of the product may collapse or snap. As a result, persons can be injured by falling metal parts.

- Prior to entering the service platforms, ensure that the snow load on the roof and protection roofs is not exceeded. The maximum permissible snow load is: 2,500 N/m^2.
- Keep roof and protection roofs free of snow.
- Wear suitable personal protective equipment for all work on the product.

NOTICE

Damage to the devices due to sand, dust or moisture penetration

Sand, dust or moisture penetration can damage the devices of the MV Power Station or impair their functionality.

- Do not open any devices during a sandstorm, precipitation or when humidity exceeds 95%.
- Only perform maintenance work when the environment is dry and free of dust.
- If the installation, maintenance or commissioning process is interrupted, mount all enclosure parts and close all doors.

NOTICE

Damage to electronic components due to electrostatic discharge

Electrostatic discharge can damage or destroy electronic components.

- Observe the ESD safety regulations when working on the product.
- Wear suitable personal protective equipment for all work on the product.
- Discharge electrostatic charge by touching grounded enclosure parts or other grounded elements. Only then is it safe to touch electronic components.

NOTICE

Damage to oil tray due to ice formation

In subfreezing conditions, water in the oil tray may freeze and damage the oil tray.

- Check the oil tray regularly for water. Remove water, if necessary.

2.3 Personal Protective Equipment

Always wear suitable protective equipment

When working on the product, always wear the appropriate personal protective equipment for the specific job.

The following personal protective equipment is regarded to be the minimum requirement:

- ☐ In a dry environment, safety shoes of category S3 with perforation-proof soles and steel toe caps
- ☐ During precipitation or on moist ground, safety boots of category S5 with perforation-proof soles and steel toe caps
- ☐ Tight-fitting work clothes made of 100% cotton
- ☐ Suitable work pants
- ☐ Individually fitted hearing protection
- ☐ Safety gloves

Any other prescribed protective equipment must also be used.

3 Product Overview

3.1 System Overview

The MV Power Station is a complete solution for PV power plants. All devices required to convert the direct current generated by the PV modules into alternating current and to feed this current into the medium-voltage grid are located in the MV Power Station. The MV Power Station is based on a modular concept in which you can select the devices according to the specific project requirements. The MV Power Station may contain one or two inverters.

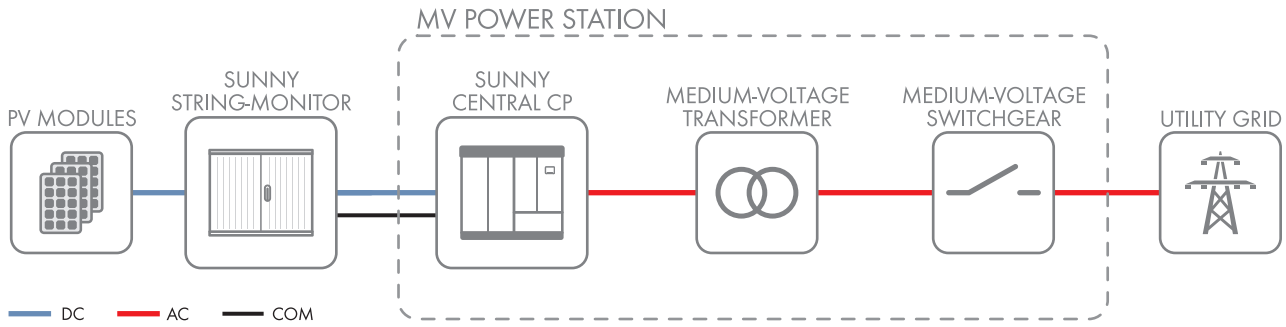


Figure 1: Design of the PV power plant with MV Power Station (example)

3.2 Design of the MV Power Station

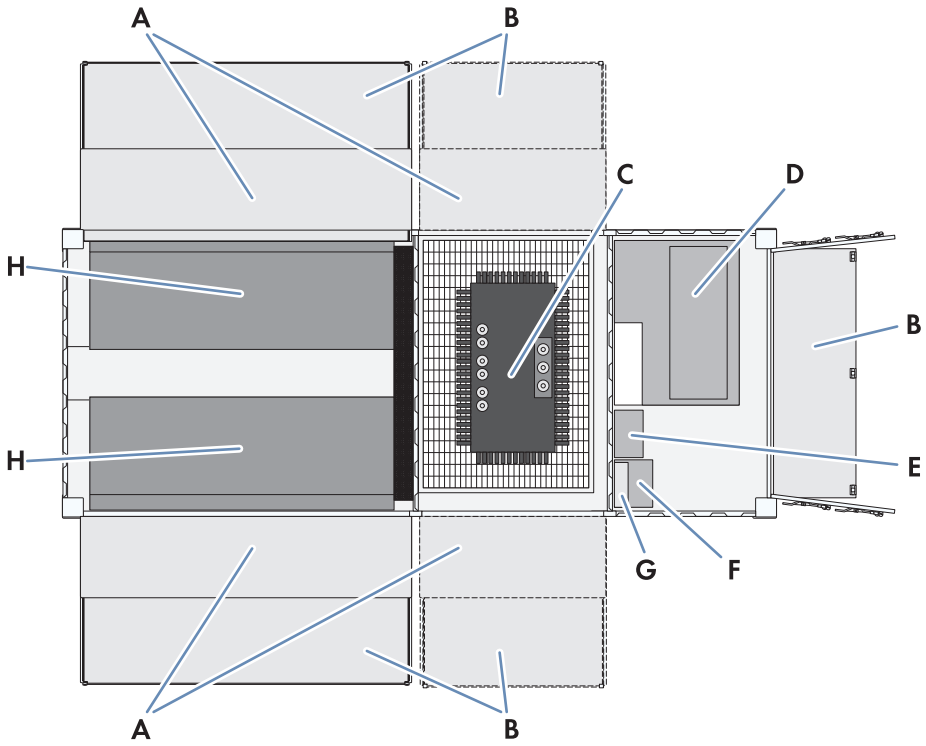


Figure 2: Design of the MV Power Station

Position	Designation	Explanation
A	Protective roof*	The roof protects the devices from direct solar irradiation.
B	Service platform*	The elevated position of the service platform facilitates operation of the devices and is part of the cooling concept of the MV Power Station.

Position	Designation	Explanation
C	MV transformer	The MV transformer converts the inverter output voltage to the voltage level of the medium-voltage grid.
D	Medium-voltage switchgear**	The medium-voltage switchgear disconnects the MV transformer from the medium-voltage grid.
E	Communit** or Control device for cascade control**	The Communit contains control and communication devices. The order option "Cascade control" allows for staggered reconnection of several medium-voltage switchgears after a grid failure or maintenance work.
F	Transformer for internal power supply **	The transformer for internal power supply provides the supply voltage for the MV Power Station and its devices. It is connected to the low-voltage side of the MV transformer (see circuit diagram).
G	Station subdistribution	The station subdistribution contains fuse and switching elements for the supply voltage.
H	Sunny Central CP XT	The inverter of the series Sunny Central CP XT is a PV inverter that converts the direct current generated in the PV array into grid-compliant alternating current.

* The protective roof and service platform for the MV transformer are only included if the MV Power Station is ordered with order option 11/1 "Sea freight".

** optional

3.3 Design of the inverter

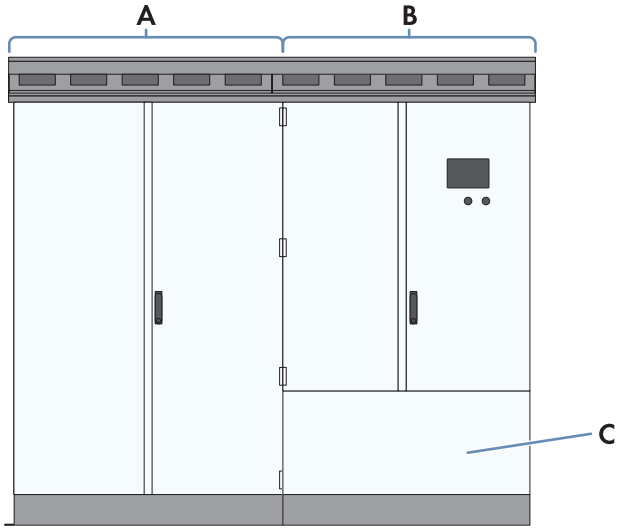


Figure 3: Design of the Inverter

Position	Designation
A	Inverter cabinet
B	Interface cabinet
C	Connection area

3.4 Devices of the Inverter

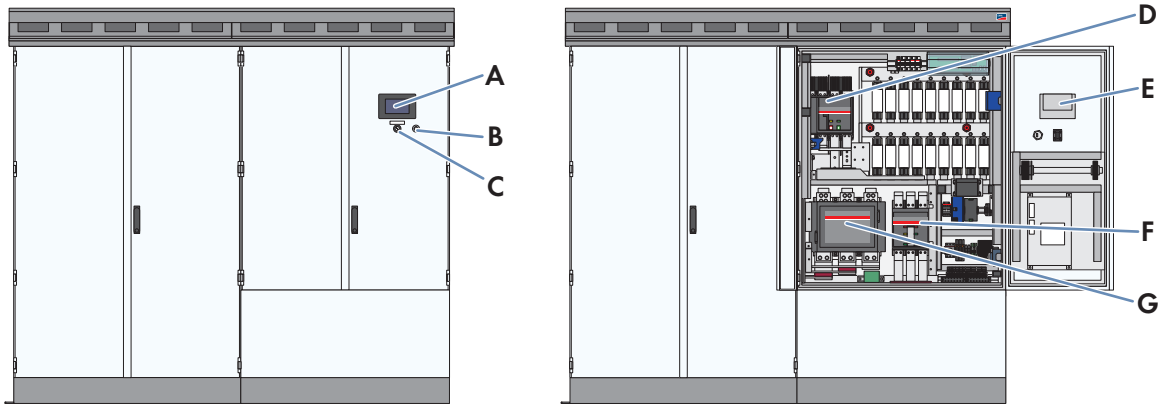


Figure 4: Devices of the inverter

Position	Device	Description
A	Touch Display	Different kinds of inverter data can be viewed on the touch display. The touch display is only used to view data. The display screen is activated by touching the touch display.
B	Service interface	The service interface allows access to the user interface.
C	Key switch	The key switch is used to switch the inverter on and off.
D	DC switchgear	The DC switchgear disconnects the inverter from the PV array.
E	SC-COM	The SC-COM is the communication unit of the inverter. The SC-COM establishes the connection between the inverter and the system operator.
F	AC disconnection unit	With the AC disconnection unit, the electrical connection between the inverter and MV transformer can be disconnected manually. In the event of residual current, the AC disconnection unit disconnects the connection between the inverter and MV transformer automatically.
G	AC contactor	The AC contactor disconnects the electrical connection between the inverter and MV transformer automatically.

3.5 Devices of the MV Transformer

The MV transformer is the link between the inverters and the medium-voltage grid.

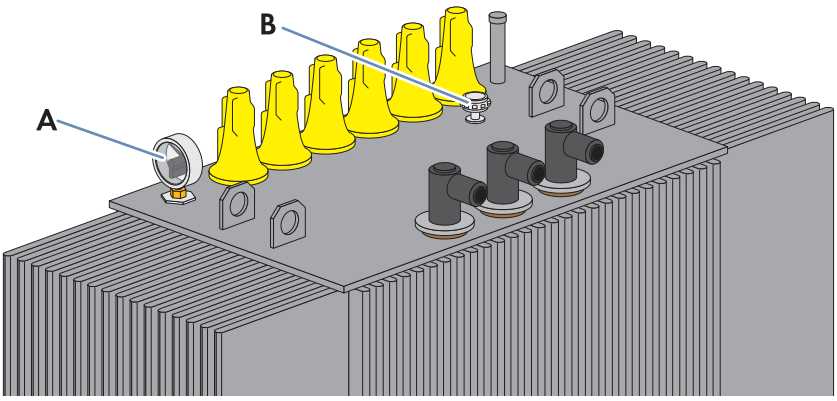


Figure 5: Devices of the MV transformer

Position	Device	Description
A	Contact thermometer or hermetic protection*	Temperature control unit or hermetic full-protection device of the MV transformer
B	Tap changer	The tap changer makes it possible to adjust the transmission ratio of the MV transformer.

* optional

3.6 Devices of the Medium-Voltage Compartment

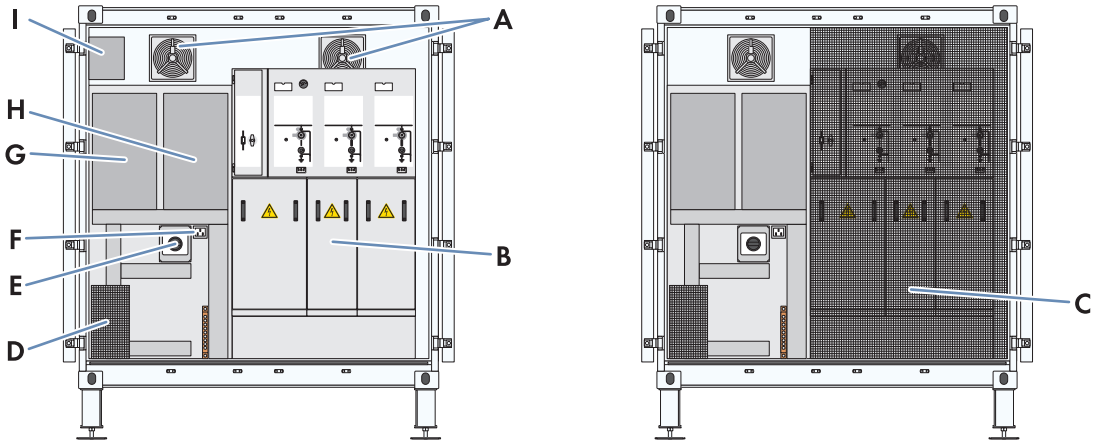


Figure 6: Devices of the medium-voltage compartment (example)

Position	Designation
A	Fans for order option "Ambient temperature up to +50°C/+55°C"
B	Medium-voltage switchgear
C	Spatial separation between medium-voltage switchgear and low-voltage devices*
D	Low-voltage transformer
E	Circuit breaker for low-voltage transformers
F	Outlet

Position	Designation
G	Station subdistribution
H	Communit or control device for order option "Cascade control"
I	Uninterruptible power supply*

* optional

3.7 Devices of the Medium-Voltage Switchgear

The medium-voltage switchgear is used to disconnect the MV Power Station from the medium-voltage grid. For the order option "Cascade control", the middle cable panel is additionally equipped with a motor drive.

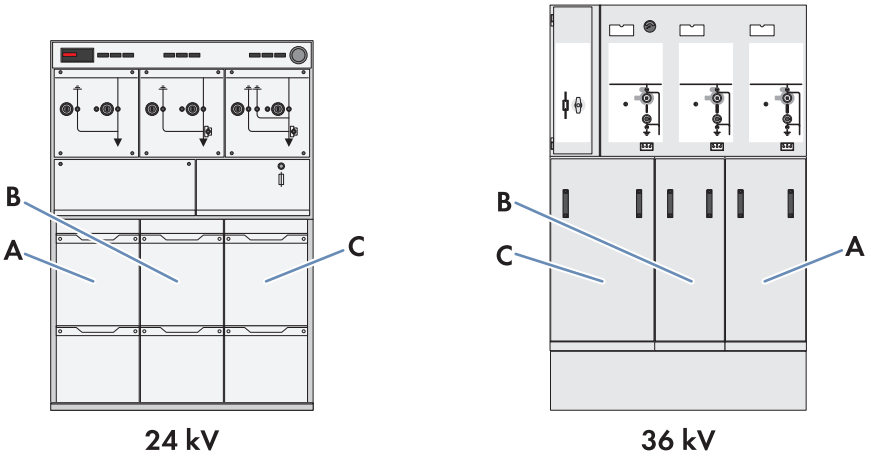


Figure 7: Devices of the medium-voltage switchgear (using the examples of a 24 kV switchgear and a 36 kV switchgear)

Position	Designation
A	Outer cable panel with load-break switch
B	Center cable panel with load-break switch, in option "Cascade control" motor-driven and equipped with auxiliary contacts on the voltage display system
C	Transformer panel, equipped with fuses or circuit breakers

3.8 Devices of the Station Subdistribution

The station subdistribution is located in the compartment of the medium-voltage switchgear and contains the circuit breakers of the supply voltages and the optional devices. Depending on the order option of the MV Power Station, the number of lines and components is different in the station subdistribution.

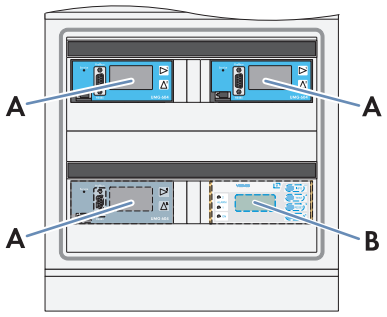


Figure 8: Optional devices of the station subdistribution (example)

Position	Designation
A	Low-Voltage Meter
B	Voltage and frequency monitoring relay for order option "Grid protection"

3.9 Devices of the Communit

The Communit is a central communication distribution unit in a large-scale PV power plant and incorporates communication devices.

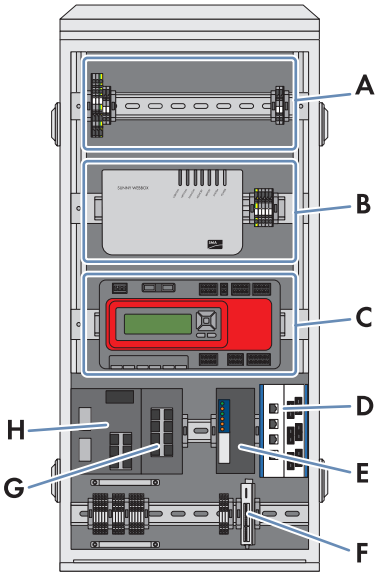


Figure 9: Devices of the Communit (example)

Position	Designation
A	Customer installation location
B	Sunny WebBox
C	SMA Cluster Controller
D	Patch panel

Position	Designation
E	Router
F	Ethernet I/O
G	Network 2
H	Network 1

3.10 Oil Tray

The oil tray collects oil which can leak from the transformer under fault conditions. The oil separators integrated in the oil tray prevent the collected oil from leaking out of the oil tray in case the oil tray is full of rain water. The rain water is heavier than the oil and runs through the oil separator whereas the oil remains in the oil tray.

An oil drain valve must be mounted at the oil tray in order to remove oil that has leaked into the oil tray. In order to facilitate maintenance work, an inspection shaft must be planned at the oil drain valve.

The oil tray must be secured against floating away.

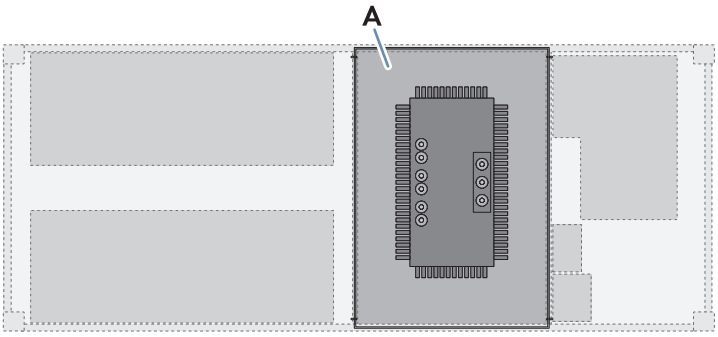


Figure 10: Positon of the oil tray

	Designation
A	Oil tray

3.11 Transformer for Internal Power Supply

The transformer for internal power supply provides supply voltage for the inverters, Communit, lighting and outlet (see circuit diagram of the MV Power Station).

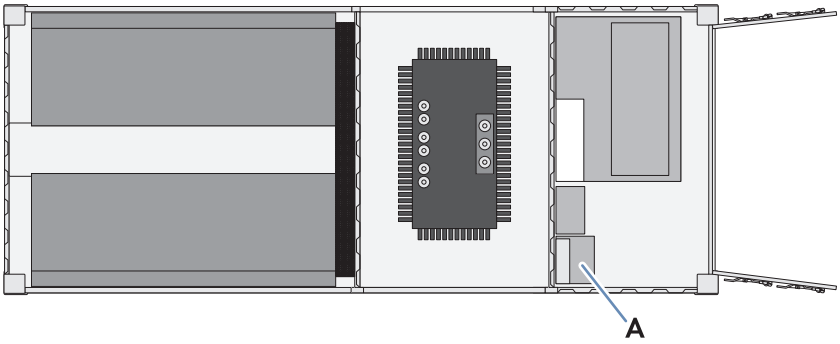


Figure 11: Position of the transformer for internal power supply

Position	Designation
A	Transformer for internal power supply

3.12 Circuitry Principle of the MV Power Station

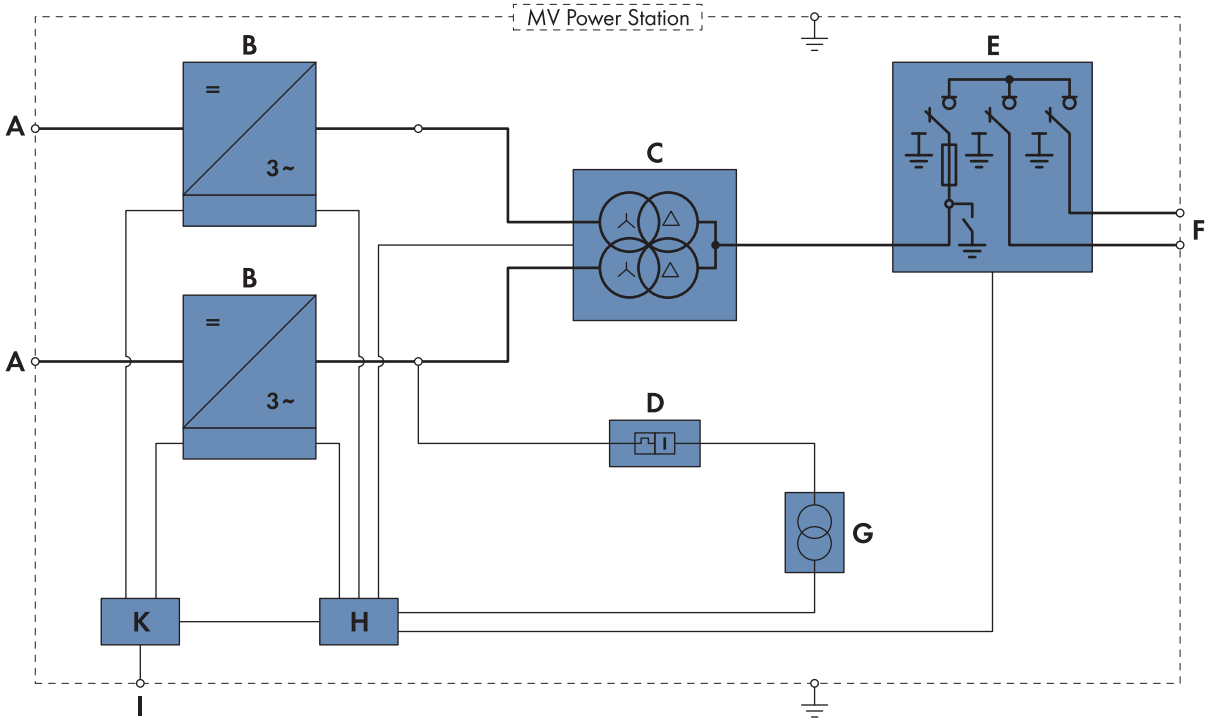


Figure 12: Circuitry principle of the MV Power Station (example)

Position	Designation
A	DC Input
B	Inverter
C	MV transformer
D	Circuit breaker for low-voltage transformers

Position	Designation
E	Medium-voltage switchgear*
F	AC Output
G	Low-voltage transformer*
H	Station subdistribution
I	External communication terminal
K	Communit*

* optional

3.13 Operating and Display Elements

3.13.1 Switch in the Inverter

3.13.1.1 Key Switch

The key switch is used to switch the inverter on and off.

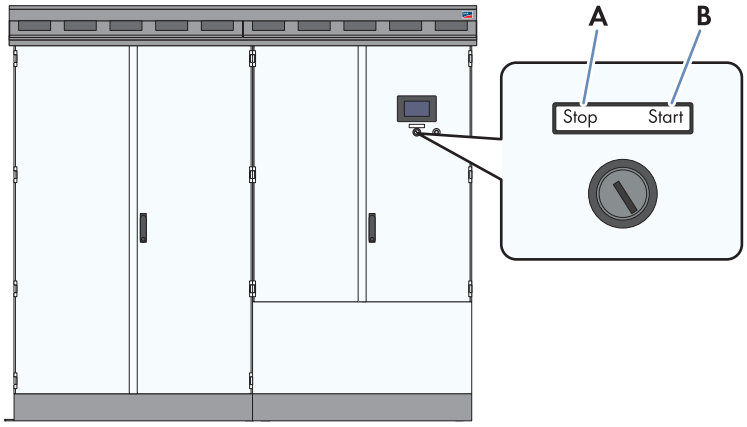


Figure 13: Switch positions of the key switch

Position	Designation
A	Switch position **Stop**
B	Switch position **Start**

Switch position Start

If the key switch is turned to **Start**, a motor drive switches the DC switchgear on and the inverter switches from the operating state "Stop" to the operating state "Grid monitoring". Provided that there is sufficient irradiation and a valid utility grid connection, the inverter switches to feed-in operation. If there is insufficient irradiation and the input voltage is therefore too low, the inverter remains in the operating state "Grid monitoring".

Switch position Stop

If the key switch is turned to **Stop** while the inverter is in the operating state "Grid monitoring", a motor drive switches the DC switchgear off. The inverter switches to the operating state "Stop". If the key switch is turned to **Stop** while the inverter is in the operating state "MPP load operation", the inverter switches to the operating state "Shutdown". Once shutdown is complete, the AC contactor and the DC switchgear are opened automatically and the inverter switches to the operating state "Stop".

3.13.1.2 AC Disconnection Unit

The AC disconnection unit disconnects the inverter from the MV transformer.

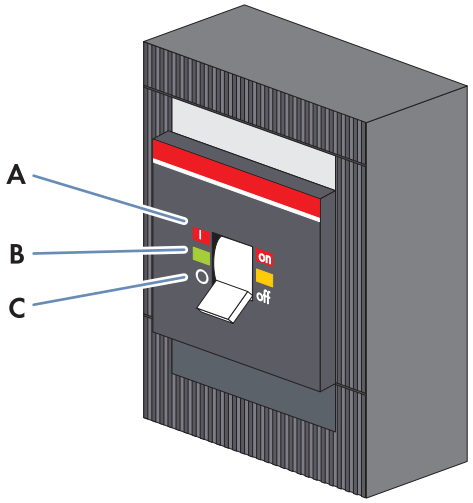


Figure 14: Switch positions of the AC disconnection unit from ABB

Position	Designation	Explanation
A	Switch position **on**	The AC disconnection unit is closed.
B	Central switch position	The AC disconnection unit was tripped and is open.
C	Switch position **off**	The AC disconnection unit is open.

3.13.1.3 DC Switchgear

The DC switchgear disconnects the inverter from the PV power plant.

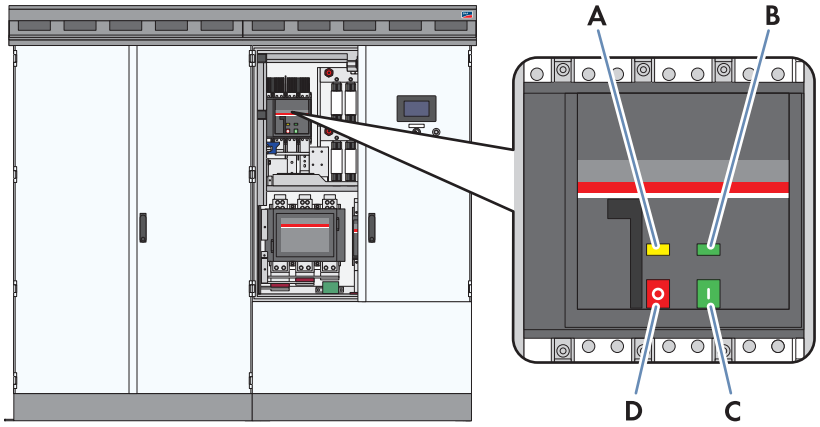


Figure 15: Indicators on the DC load-break switch

Position	Designation
A	Spring status indicator
B	Position indicator
C	ON button
D	OFF button

3.13.2 Switch in the Station Subdistribution

Reference designations are attached to the individual devices of the station subdistribution.

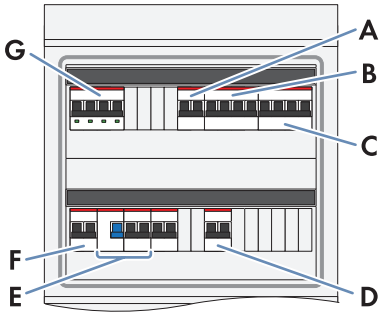


Figure 16: Circuit breaker in the station subdistribution (example)

Position	Designation
A	Circuit breaker for fans with order option "Ambient temperature up to +50°C/+55°C"
B	Circuit breaker of the supply voltage of inverter 1
C	Circuit breaker of the supply voltage of inverter 2
D	Circuit breaker of the contact thermometer or hermetic protection*
E	Residual-current device and circuit breaker of the outlet
F	Circuit breaker of the Communit and lighting
G	Main switch of the supply voltage of the MV Power Station

* optional

3.13.3 Switch on the Medium-Voltage Switchgear

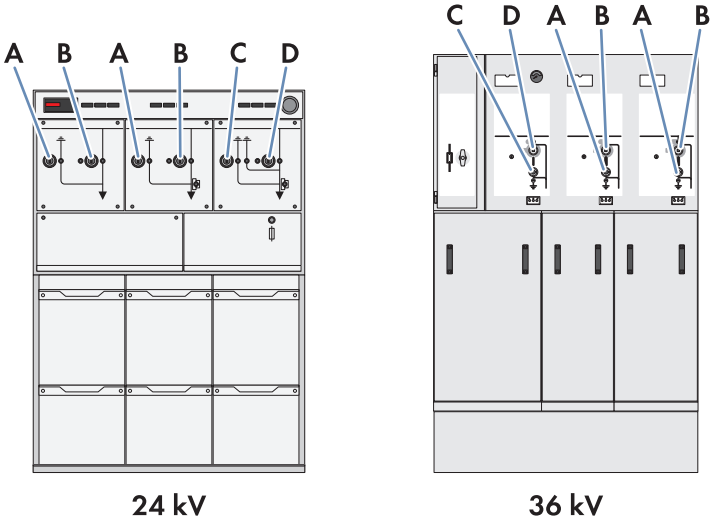


Figure 17: Control panels of the medium-voltage switchgear with fuses in the transformer panel (example)

Position	Designation
A	Grounding switch of the cable panel
B	Load-break switch of the cable panel

Position	Designation
C	Grounding switch of the transformer panel*
D	Load-break switch of the transformer panel

* You will find the position of the control panels of the medium-voltage switchgear with circuit breaker in the medium-voltage switchgear documentation.

3.13.4 Switch on the Control Device for Cascade Control

For the order option "Cascade control", a control device for the medium-voltage switchgear is integrated in the medium-voltage compartment. The control device enables the automatic reconnection of several medium-voltage switchgears (see Section 13.6 "Cascade Control", page 209).

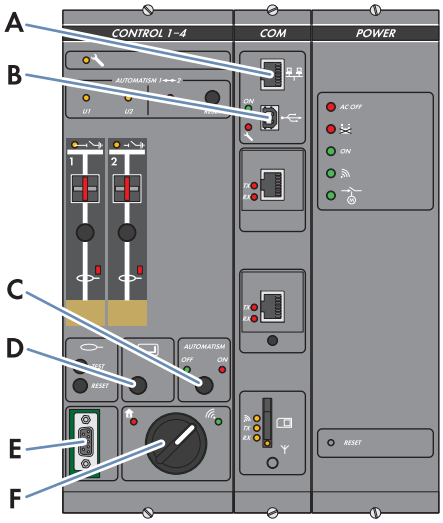


Figure 18: Switch and devices of the control device for order option "Cascade control"

Position	Designation
A	Network port
B	USB port
C	Automatic button to activate or deactivate the automatic function
D	Confirmation button
E	Serial interface RS232
F	Rotary switch to switch between on-site operation and remote operation

3.13.5 MV Transformer Access Lock

With the order option "Country package, France", the MV transformer can be secured against reconnection.

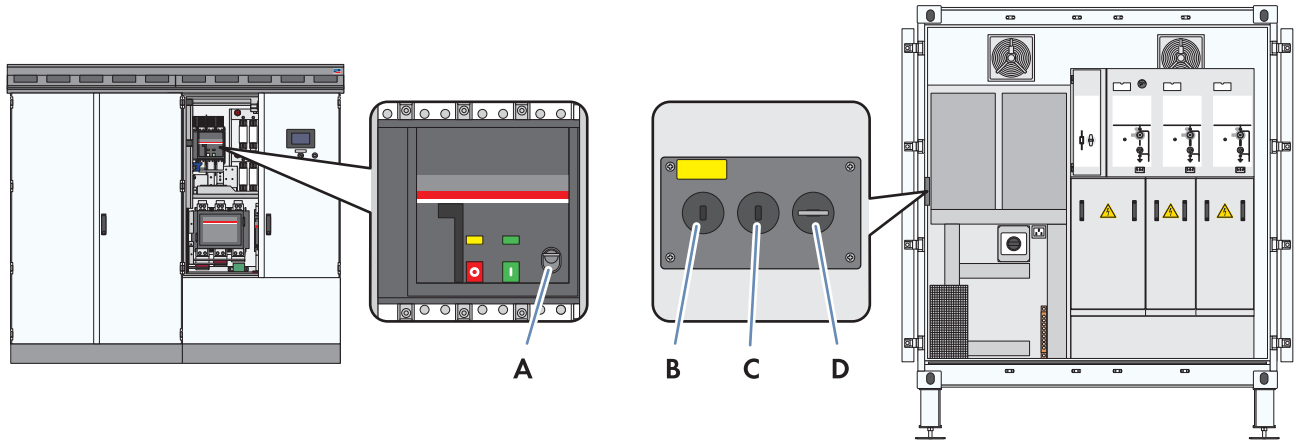


Figure 19: Position of the MV transformer access lock

Position	Designation
A	Key for the inverter DC switchgear
B	Key switch for inverter 1
C	Key switch for inverter 2
D	Key for the medium-voltage switchgear transformer panel

You will find the position of the key switch on the medium-voltage switchgear in the medium-voltage switchgear documentation.

Order for unlocking the access lock

The keys are locked via the mechanical key switches. To release the keys, the key switches must be unlocked in a specific order. Unlocking is performed in reverse order.

No.	Requirement	Release
1.	The inverter DC switchgear is open.	The key for the inverter DC switchgear (**A**) is unlocked.
2.	The key switches for inverter 1 (**B**) and 2 (**C**) are locked with the keys of the DC switchgears.	The key for the medium-voltage switchgear transformer panel (**D**) is unlocked.
3.	The key switch of the medium-voltage switchgear transformer panel is locked with the key for the transformer panel. With a medium-voltage switchgear with load-break switch, the load-break switch must also be opened (see medium-voltage switchgear documentation).	The key for the grounding switch on the transformer panel of the medium-voltage switchgear is unlocked.
4.	The transformer clamping unit on the MV transformer is unlocked with the grounding switch key.	The transformer clamping unit on the MV transformer can be removed, e.g. for maintenance work.

3.13.6 Emergency switch

With the order option "Country package, France", the MV Power Station is equipped with an emergency switch.

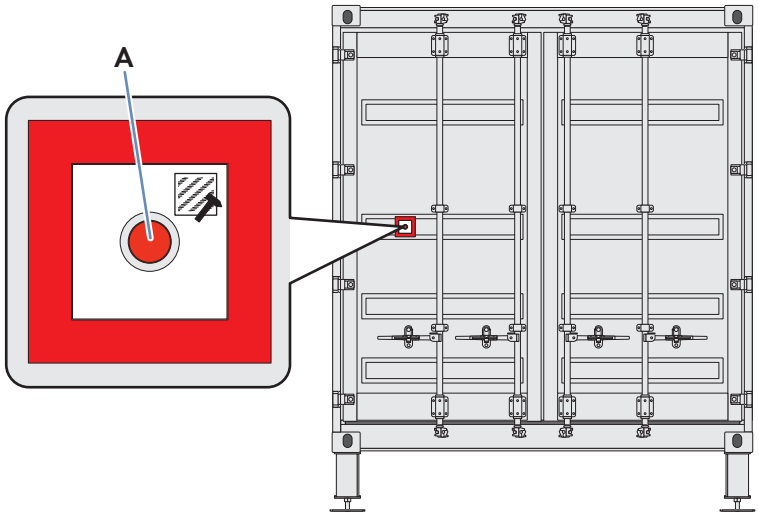


Figure 20: Emergency switch position

Position	Designation
A	Emergency switch

The medium-voltage switchgear can be switched off with the emergency switch.

The emergency switch is only to be used in an emergency.

3.13.7 Touch Display

3.13.7.1 Design

The touch display is used to display instantaneous values and parameter settings. Tapping the symbols on the touch display activates the corresponding functions. If the touch display has not been touched for five minutes, the display is locked and the logged-in user will be logged out. By tapping the characters "S", "M" or "A", you can unlock the display again.

The touch display is divided into three areas.

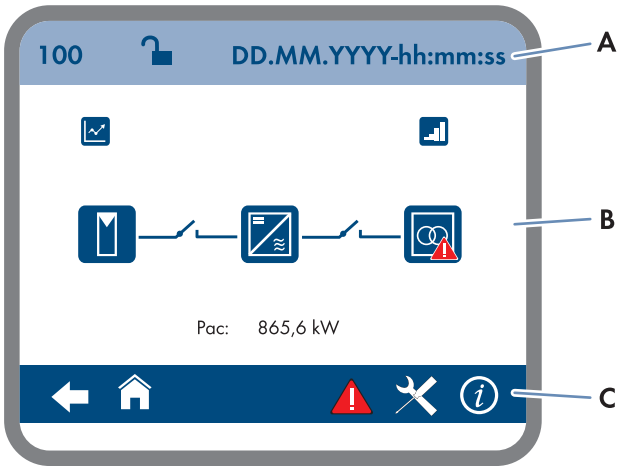


Figure 21: Design of the touch display

Position	Designation	Explanation
A	Status info line	Number of the active menu, login status and time
B	Information field	Area of the main menu
C	Navigation line	Navigation area

3.13.7.2 Explanation of Symbols

Information field

You can access the following sub-menus and screens from the information field:

Symbol	Designation	Explanation
	E-today line graph	Diagram 103: Representation of energy fed in during the current day in kWh.
	Bar chart	Diagram 104: Representation of energy fed in during the last 14 days in kWh.
	DC side	Representation of the instantaneous values • PV power in W • Insulation resistance in Ω • PV current in A • PV voltage in V • Diagram of string-current monitoring – Diagram 132 and 133: Group currents of the individual Sunny String-Monitors – Diagram 140 to 146: String currents of the individual Sunny String-Monitors
	String-current monitoring of the DC side	Representation of the instantaneous values of the string-current monitoring of the individual Sunny String-Monitors

Symbol	Designation	Explanation
	Switch on DC or AC side closed	If you see this symbol between the "DC side" symbol and the "Inverter data" symbol, the DC switchgear is closed. If you see this symbol between the symbol "Inverter data" and the symbol "AC side", the AC contactor is closed.
	Switch on DC or AC side open	If you see this symbol between the "DC side" symbol and the "Inverter data" symbol, the DC switchgear is open. If you see this symbol between the symbol "Inverter data" and the symbol "AC side", the AC contactor is open.
	Status of switches on DC or AC side unknown	If you see this symbol between the "DC side" symbol and the "Inverter data" symbol, the switch status of the DC switchgear is not known. If you see this symbol between the symbol "Inverter data" and the symbol "AC side", the switch status of the AC contactor is unknown.
	Inverter data	Representation of the following inverter data: • Device type • Operating state • Symbol for utility grid menu • Symbol for temperature display • Symbol for fan display
	AC side	Representation of the following instantaneous values: • Active power in W • Reactive power in VAr • Power frequency in Hz • AC current in A • AC voltage in V
	grid	First menu page: • Active mode of active power limitation • Target active power in kW • Actual active power in kW Second menu page • Active mode of reactive power setpoint • Target reactive power in VAr • Target displacement power factor cos φ • Target excitation type of the displacement power factor • Actual reactive power in VAr • Actual displacement power factor cos φ • Actual excitation type of the displacement power factor

Settings Menu

Symbol	Designation	Explanation
	Language selection	Select this symbol to open the language selection menu.
	Brightness setting	Select this symbol to open the brightness setting menu.
	Time setting	Select this symbol to open the time setting menu.
	Format selection	Select this symbol to open the format selection menu.
	Password entry	Select this symbol to open the password entry menu.

Navigation line

Symbol	Designation	Explanation
	Back	Select this symbol to go back to the previous page.
	Homepage	Select this symbol to go to the homepage.
	Settings	• Language selection • Brightness setting • Time setting • Format selection • Password entry
	Information	• OS: version of the operating system • App.: version of the application software • SC-COM version: SC-COM software version • Ser.No.: inverter serial number • Hardware: hardware version and serial number of the SC-COM
	Error	• ErrNo: error number • TmsRmg: time until reconnection • Msg: error message • Dsc: corrective measure
 	Service	• Telephone receiver: Contact Service. • Tool: Contact your installer.

3.13.8 LEDs of the SC-COM

3.13.8.1 LEDs on the Enclosure

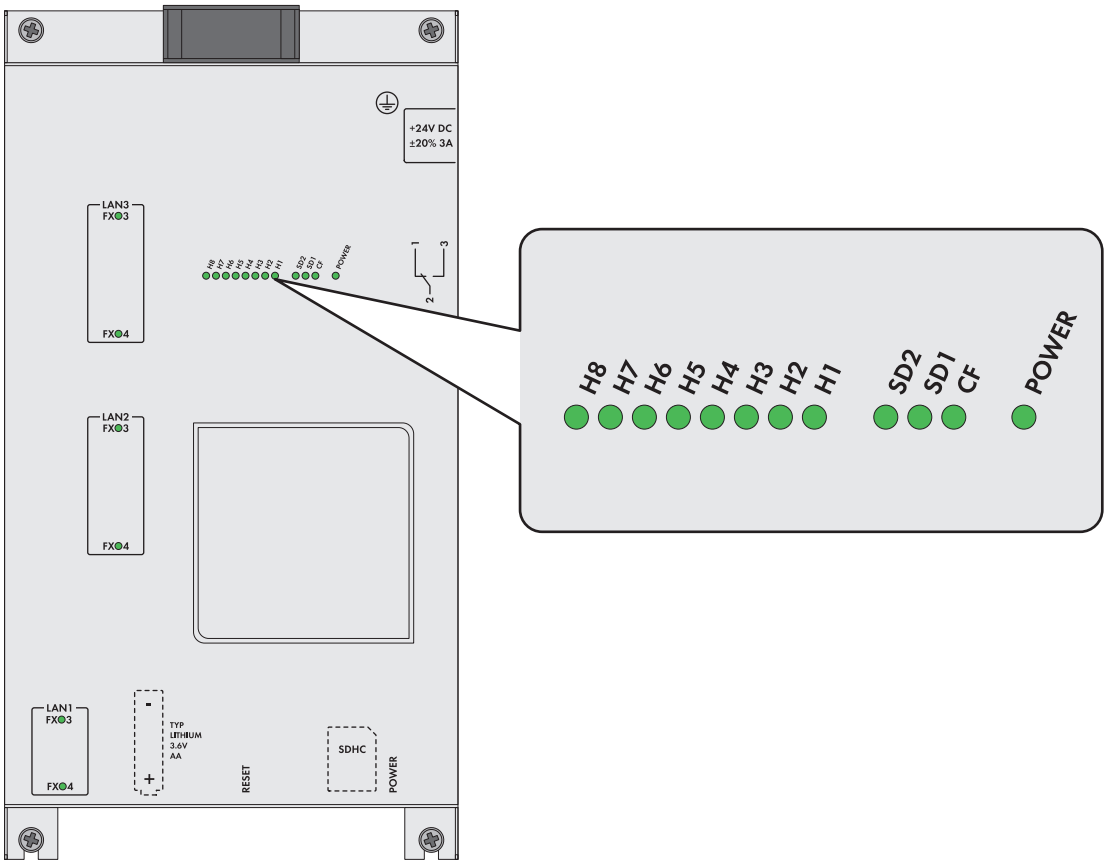


Figure 22: LEDs on the enclosure

LED designation	Status	Explanation
POWER	glowing green	The SC-COM is supplied with voltage.
	off	The SC-COM is not supplied with voltage.
SD1	flashing green	Read or write access to system drive
SD2	flashing green	Read or write access to internal data drive
CF	flashing green	Read or write access to external SD memory card
H1	flashing green	The SC-COM is transmitting data to Sunny Portal/FTP server.
	glowing green	The most recent data transmission to Sunny Portal/FTP server was successful.
	glowing red	The most recent data transmission to Sunny Portal/FTP server has failed.
	off	Data transmission to Sunny Portal/FTP server is deactivated.

LED designation	Status	Explanation
H2	flashing green	The SC-COM is communicating with the devices connected within the system.
	glowing green	Internal communication has taken place in the last five minutes.
	glowing red	An error has occurred in the internal communication.
	off	No internal communication for more than five minutes.
H3	flashing red	The SC-COM is starting up.
	glowing red	An error has occurred in the SC-COM.
	glowing green	The SC-COM is ready for use.
H4	glowing green	An internal memory card exists and less than 92% of its storage capacity is used.
	glowing red	The internal memory card is full and the oldest saved data is being overwritten.
	flashing red	92% of the storage capacity of the internal memory card is used.
H5	glowing green	An external memory card exists and less than 92% of its storage capacity is used.
	glowing red	The external memory card is full.
	flashing red	92% of the storage capacity of the external memory card is used.
	off	There is no external memory card.
H6	-	Not assigned
H7	-	Not assigned
H8	flashing green	Application is running.

3.13.8.2 LEDs on the Network Port

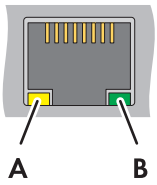


Figure 23: LEDs on the network port

Position	LED	Color	Status	Explanation
A	Speed	yellow	on	100 MBit data transfer rate
			off	10 MBit data transfer rate
B	Link/Activity	green	on	Connection (Link) established.
			flashing	The SC-COM is transmitting or receiving data (Activity).
			off	No connection established.

3.13.8.3 LEDs on the Optical Fiber Terminals

The SC-COM is also available with pre-wired optical fiber connections. If the optical fibers are connected to the splice box of the inverter, the status of the connection will be indicated by the LEDs of the SC-COM.

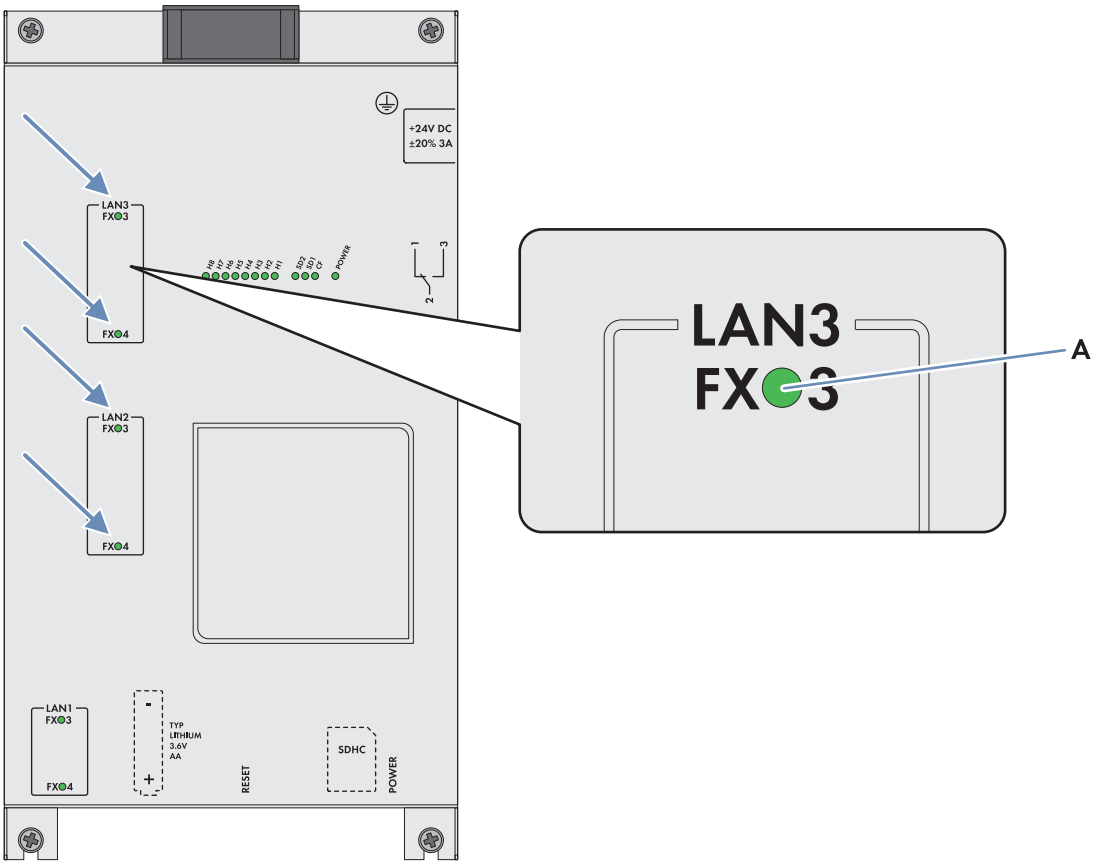


Figure 24: LEDs for the status of the optical fiber connection

Position	LED	Color	Status	Explanation
A	Link / Activity	green	on	Connection (Link) established.
			flashing	The SC-COM is transmitting or receiving data (Activity).
			off	No connection established.

3.13.9 User Interface

3.13.9.1 Design of the User Interface

Via the user interface, you can set the communication of the devices of your PV power plant, configure the inverter parameters and read off error messages and operating data.

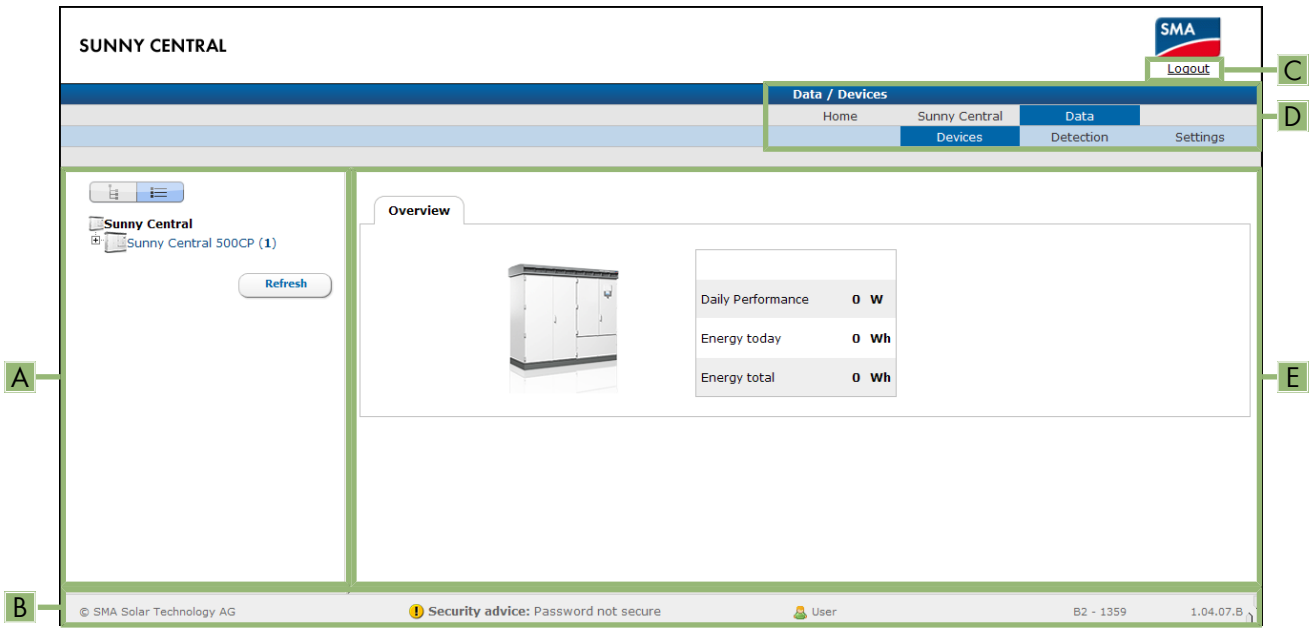


Figure 25: Design of the user interface (example)

Position	Designation
A	Tree view or device view
B	Status bar
C	Logout button
D	Navigation bar
E	Content area

3.13.9.2 Tree View and Device View

You can call up data of the individual devices of your PV power plant in the tree view or the device view. Depending on which view you have selected, the devices are sorted differently.

Symbol	Designation	Explanation
	Tree view	In the tree view, the user interface shows the devices in the order in which they are connected to the data bus.
	Device view	In the device view, the user interface shows all devices sorted by device type. The number shown in parentheses indicates the number of devices of a device type.

3.13.9.3 Status Symbols

Depending on the status of the device communication, the device symbols are displayed in the tree or device view with various status symbols.

Symbol	Explanation
	The inverter is ready for operation.

Symbol	Explanation
	There is an error in the inverter.
	An error has occurred in the communication with the inverter.

3.14 Symbols on the Product

The following gives an explanation of all the symbols found on the devices of the MV Power Station and on the type labels.

Symbol	Designation	Explanation
	CE marking	The product complies with the requirements of the applicable EU directives.
	Protection class I	All electrical equipment is connected to the grounding conductor system of the product.
	Degree of protection IP54	The product is protected against interior dust deposits and splashing water from all angles.
	Beware of a danger zone	This warning symbol indicates a danger zone. Be particularly vigilant and cautious when working on the product.
	Beware of dangerous voltage	The product operates at high voltages. All work on the product must be carried out by qualified persons only.
	Beware of hot surface	The product can get hot during operation. Avoid contact during operation. Allow the product to cool down sufficiently before carrying out any work. Wear personal protective equipment such as safety gloves.
	Warning of two voltage types*	Two voltage types are live in the product: direct current from the PV power plant and alternating current from the utility grid. Qualified persons must be trained in the dangers and risks of both voltage types.
	Switching forbidden*	During any work, the product may not be reconnected after it has been disconnected from voltage sources.
	General mandatory sign*	Observe all symbols on the product and warning messages.
	Use hearing protection	The product generates loud noises. When working on the product, wear hearing protection.
	Observe the documentation	Observe all documentation supplied with the product.

* With the order option "Country package, France"

4 Transport and Mounting

4.1 Safety during Transport and Mounting

⚠ WARNING

Danger of crushing if raised or suspended loads tip over, fall or sway

Vibrations or careless or hasty lifting and transportation may cause loads to tip over or fall. This can result in death or serious injury.

- Follow all national transportation standards and regulations.
- Never allow anyone to walk or stand under a suspended load at any time.
- Always transport the load as close to the ground as possible.
- Use all suspension points for transportation.
- Use the tie-down and crane points provided for transportation.
- Avoid fast or jerky movements during transport.
- Always maintain an adequate safety distance during transport.
- All means of transport and auxiliary equipment used must be designed for the weight of the load.
- Wear suitable personal protective equipment for all work on the product.

NOTICE

Damage to the frame construction due to uneven support surface

If the product is set down on uneven surfaces, components may distort. This may lead to moisture and dust penetration into the components.

- Never place the product on an unstable, uneven surface; not even for a short period of time.
- The unevenness of the support surface must be less than 0.25%.
- The support surface must be suitable for the weight of the product.
- Prior to storage, ensure that the doors of the product are tightly closed.

⚠ CAUTION

Danger of crushing and collision when carelessly working on the product

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

i Clean the closed station container of the MV Power Station with clear water after maritime transport.

High humidity and salt water can cause corrosion of the station container during maritime transport. It is recommended to clean the station container with clear water prior to installation. This will inhibit the corrosion process. Coat the affected areas in order to prevent further corrosion.

4.2 Requirements for Transport and Mounting

4.2.1 Requirements and Ambient Conditions

☐ The maximum permissible gradient of the access road is 4%.

☐ During unloading, a distance of at least 2 m to neighboring obstacles must be observed.

☐ The access road must be constructed to ensure that a truck (16 m long, 2.70 m wide, 5 m high, and a total weight of 50 t) can reach the unloading site. The curve radius of the truck must be taken into account.

- ☐ For trucks with several containers, the access roads and the unloading site must be designed corresponding to the length, width, height, total weight and curve radius of the truck.
- ☐ The unloading site for the crane and truck must be firm, dry and horizontal.

4.2.2 Center of Gravity Marker

The center of gravity of the MV Power Station is not in the middle of the unit. Take this into consideration when transporting the MV Power Station. The center of gravity depends on the device class of the MV Power Station.

The center of gravity of the MV Power Station is marked on the station container.

Figure 26: Center of gravity symbol

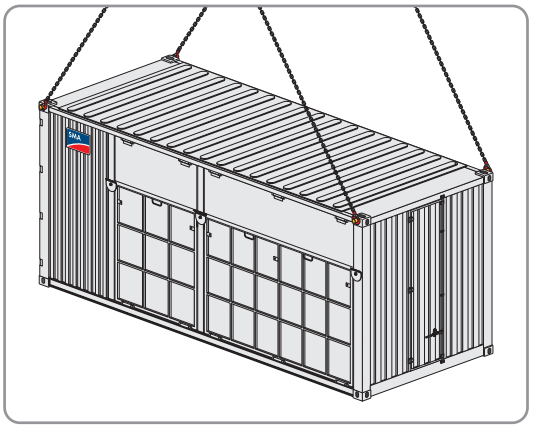
4.3 Transporting the MV Power Station Using a Crane

Requirements:

- ☐ The crane and hoist must be suitable for the weight.
- ☐ The hoist must be properly connected to the crane.
- ☐ The factory-fitted transport lock on the devices of the MV Power Station must be in place.
- ☐ The doors of the MV Power Station must be closed.

Procedure:

1. Attach the hoist to the four upper or lower lifting lugs on the MV Power Station. When the hoist is attached to the lower lifting lugs, you should protect the enclosure of the MV Power Station from mechanical damage by the hoist.



2. Ensure that the hoist is attached correctly.
3. Slowly raise the MV Power Station and check if the hoist is taut evenly.
4. If the MV Power Station is not level when raised, lower it back down to the ground.
5. Make sure that the hoist is attached so that the MV Power Station will be lifted level. If necessary extend the chains of the hoist with shackles, so that the MV Power Station is in a horizontal position.
6. Raise the MV Power Station slightly.
7. Transport the MV Power Station to its final position as close to the ground as possible.
8. If the MV Power Station is to be transported directly to the mounting location and installed on the support surface, attach the support feet (see Section 4.6, page 44).
9. Set the MV Power Station down. The support surface must be suitable for the weight of the MV Power Station in accordance with the requirements (see "Information on Transport and Mounting of the MV Power Station").

4.4 Transporting the MV Power Station by Truck, Train and Ship

Requirements:

- ☐ The means of transport must be equipped with container locks.
- ☐ The doors of the MV Power Station must be closed.
- ☐ The factory-fitted transport lock on the devices of the MV Power Station must be in place.
- ☐ If transported by train, the MV Power Station must be loaded on railroad cars with shock absorbers.

Procedure:

1. Load the MV Power Station onto the means of transport (see Section 4.3, page 42).
2. Use container locks to secure the MV Power Station by at least four upper or lower corner castings.

4.5 Removing the Supplied Mounting Material from the MV Power Station

Upon delivery, the supplied mounting material is located in the compartment of the medium-voltage switchgear.

Procedure:

1. Temporarily store the MV Power Station in a suitable location.
2. Open the medium-voltage switchgear compartment (see Section 12.1, page 159).
3. Set up the medium-voltage switchgear service platform (see Section 12.2, page 162).
4. Remove the required mounting material from the medium-voltage switchgear compartment (see Section 16.1 "Scope of Delivery", page 256).
5. Remove the medium-voltage switchgear service platform.
6. Close the medium-voltage switchgear compartment (see Section 12.1, page 159).

4.6 Attaching the Support Feet to the MV Power Station

The MV Power Station must be installed on the support surface with six support feet. The support feet for the station container can be found in the accessories kit in the medium-voltage switchgear compartment. The four outer support feet can be attached to the MV Power Station using the T-head bolts. The center support feet must be tightened. The height of the standard support feet is adjustable (if necessary). After the mounting process of the MV Power Station is completed, the height of the standard support feet can no longer be adjusted.

Requirement:

☐ To attach the support feet to the MV Power Station, you must place the station on temporary platforms (e.g. crane support plates). The platforms must be at least 450 mm high.

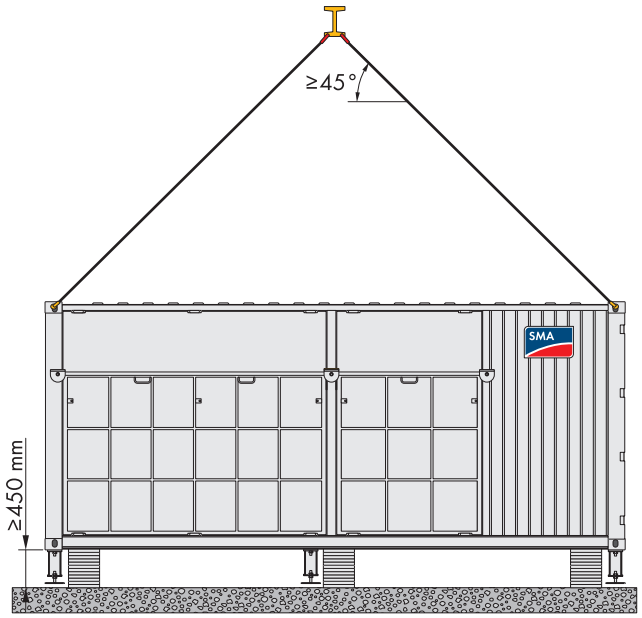


Figure 27: Attachment of the support feet during unloading of the MV Power Station at the mounting location

Required mounting material (included in the scope of delivery):

☐ Six support feet for the MV Power Station

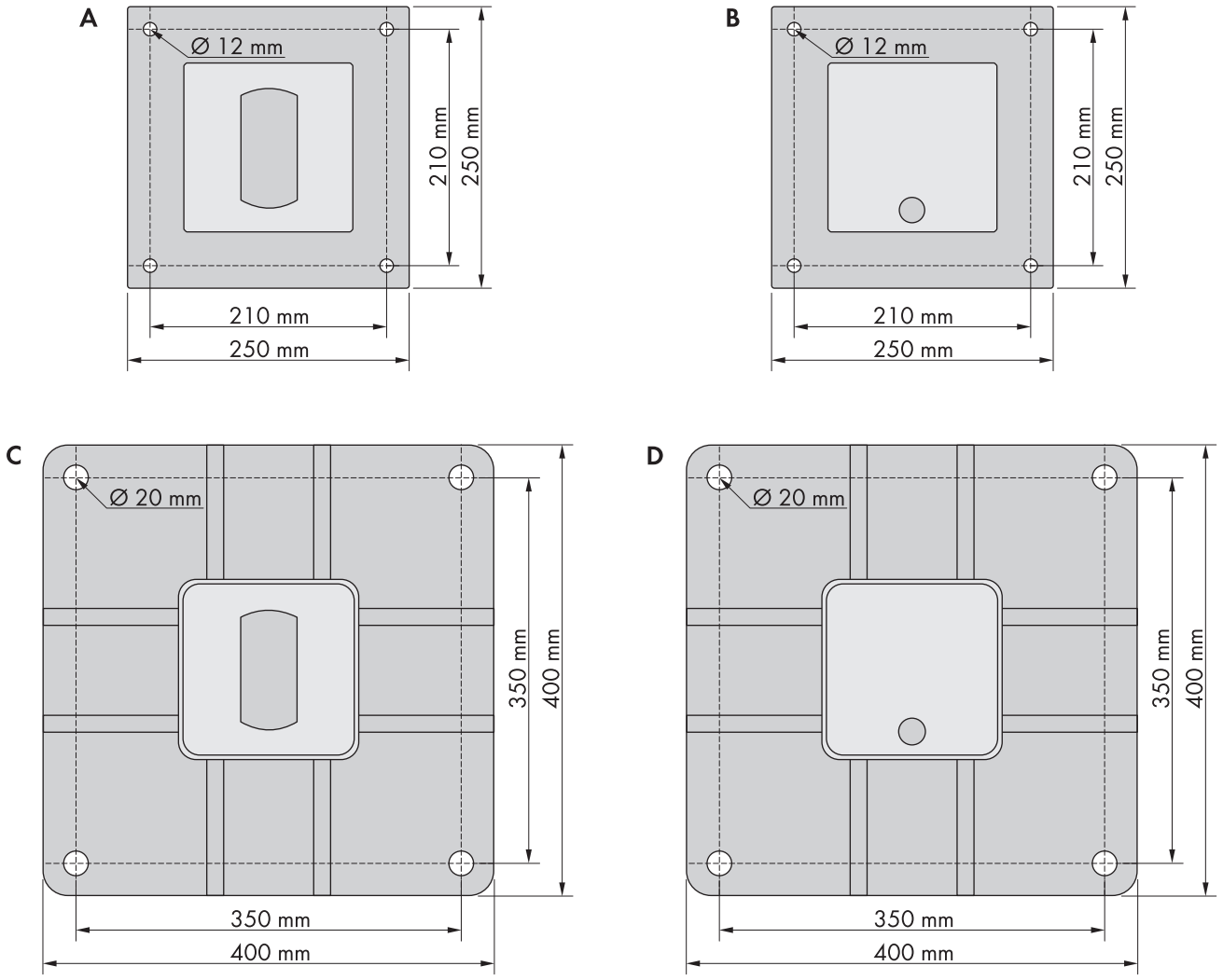


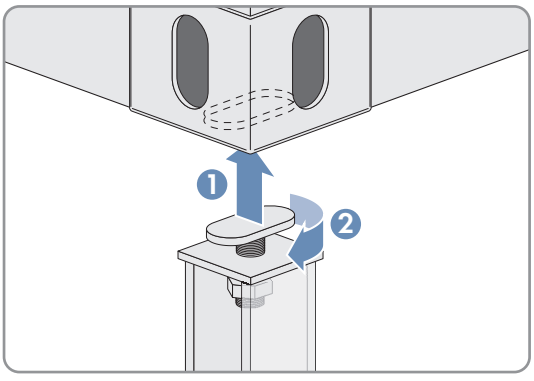
Figure 28: Dimensions of the support feet

Position	Designation
A	Outside standard support foot with a height of 350 mm (adjustable height ±20 mm)
B	Central standard support foot with a height of 350 mm (adjustable height ±20 mm)
C	Outside support foot* with a height of 368 mm (non-adjustable height)
D	Central support foot* with a height of 368 mm (non-adjustable height)

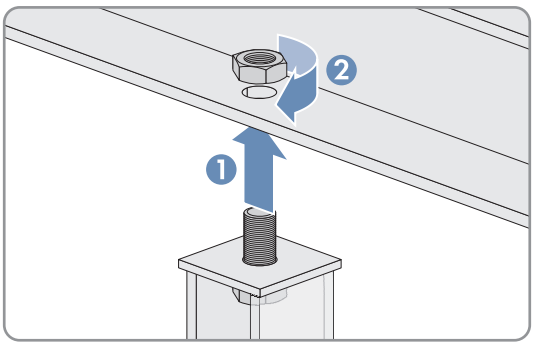
* For the order option "Earthquake and storm qualification"

Procedure:

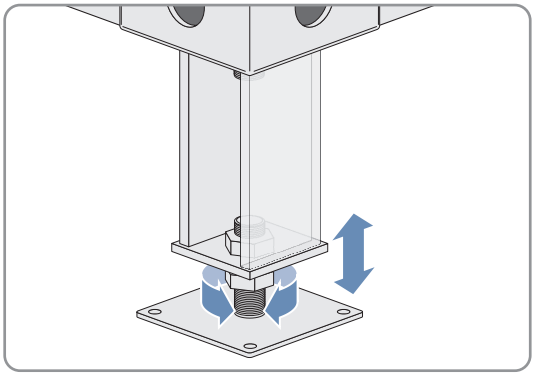
1. Insert the T-head bolt of the support foot in the corner casting of the station container and twist to lock.



2. Tighten the nut of the T-head bolt (width across flats: 36 mm).
3. Repeat steps 1 and 2 for each support foot with T-head bolt.
4. Align the stud bolt of the support foot for the side of the container outwards, guide it into the middle fitting of the station container and mount it with the nut (width across flats: 30 mm).



5. Mount the second middle support foot as described in step 4.
6. Adjust the height of the support feet using the bottom nuts (width across flats: 36 mm). The height of the support foot must be at least 350 mm. Align the support foot so that the base plate is flush with the MV Power Station.



7. Set the height of the support feet of the MV Power Station so that the device is horizontal and its weight is equally distributed over all support feet.

4.7 Mounting the MV Power Station

The MV Power Station can be mounted and anchored on flagstones, pile-driven steel pillars, strip foundations, concrete slabs or concrete pillars (see "Information on Transport and Installation of the MV Power Station"). The customer is responsible for mounting and anchoring the MV Power Station on the support surface. Which foundation option is selected is at the discretion of the customer. If the mounting location is subject to strong winds, the support feet should be anchored to the foundation.

For the option "Seismic and Storm Qualification", stricter requirements apply to the foundations. The MV Power Station comes with special support feet, which need to be integrated into the concrete foundation. Furthermore, the protection roofs for the inverter compartment and transformer compartment must be removed. For further information on the installation for the option "Seismic and storm qualification," consult the transport and installation conditions.

The cooling concept of the MV Power Station uses the service platforms to dissipate the warm exhaust air. For this reason, the MV Power Station must be operated with open service platforms. To enable this, support feet must be attached to the service platforms. The support feet for the service platforms can be found in the accessory kit in the medium-voltage switchgear compartment. Mounting of the service platforms is the responsibility of the customer. Mounting of the service platforms must be completed prior to commissioning.

Hand rails for the service platforms of the MV Power Station

The service platforms are provided by SMA Solar Technology AG.

Local regulations for hand rails must be observed. Hand rails for the service platforms are not included in the scope of delivery of the MV Power Station and must be provided on-site.

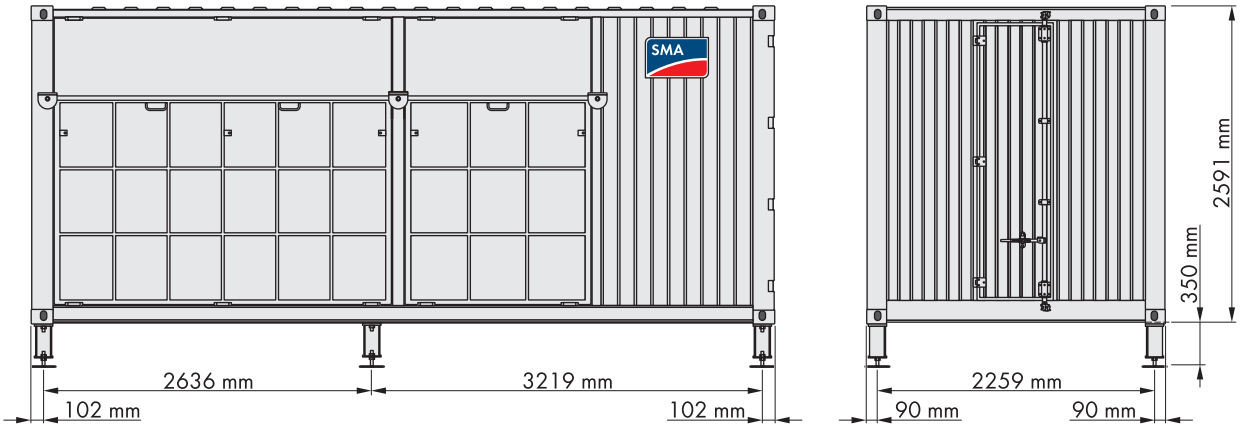


Figure 29: Position of the support feet

Requirements:

☐ The foundation requirements must be complied with (see "Transportation and Installation Requirements - Medium Voltage Power Station").

☐ Pea gravel ground and the foundation option must be prepared (see "Transportation and Installation Requirements - Medium Voltage Power Station").

☐ The support feet must be attached to the MV Power Station (see Section 4.6, page 44).

☐ The length of the support feet on the MV Power Station must be at least 350 mm.

⚠ CAUTION

Risk of injury due to inappropriate transport of the oil tray

The oil tray for the MV Power Station is very heavy. If you try to move the oil tray without auxiliary equipment, you may suffer injury.

- Only transport the oil tray using a suitable means of transport.
- Using a suitable means of transport, transport the oil tray as close to the ground as possible.

⚠ CAUTION

Risk of injury if heavy service platforms are lowered too fast

The service platforms of the MV Power Station are very heavy. If service platforms are folded down too fast or dropped, persons could be injured.

- Have at least two people pull each service platform forwards and down.
- Always wear suitable protective equipment.

NOTICE

Damage to oil tray due to water undermining

In case of strong rain, the oil tray can be undermined and float away.

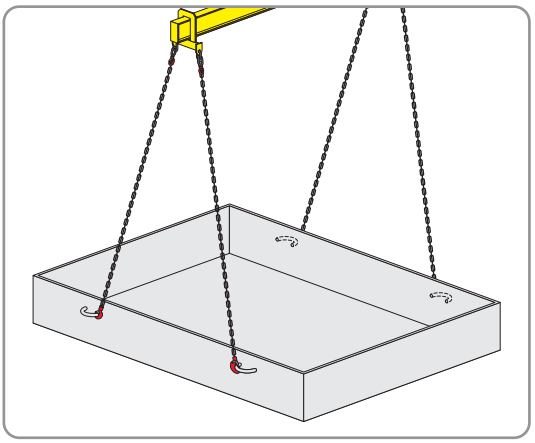
- Secure the oil tray against floating away.

Position of the cables when mounting the MV Power Station

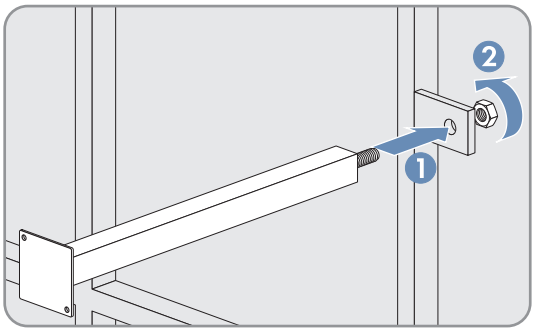
To prevent damage to the previously laid cables during mounting of the MV Power Station, the cables must be laid on the foundation as flat as possible.

Procedure:

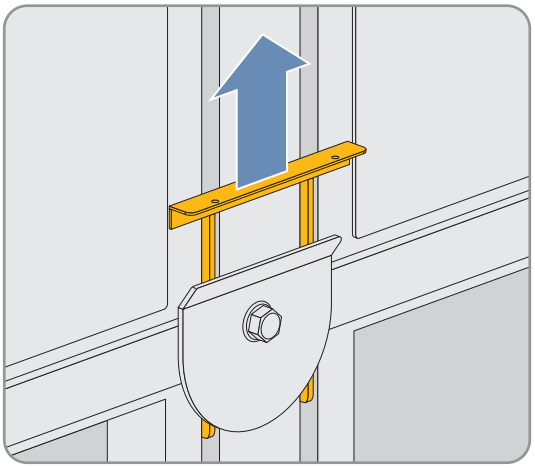
1. Use a crane to set the oil tray down in the appropriate position so that it is aligned underneath the transformer compartment of the MV Power Station. Take the heavy weight of the oil tray into account.



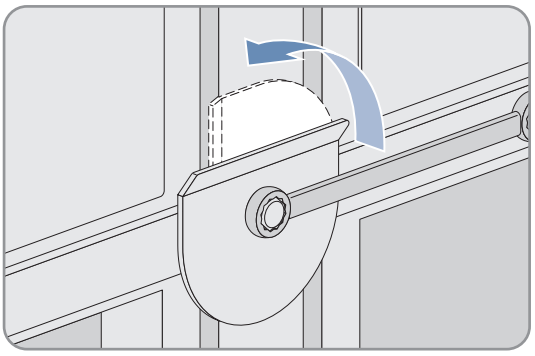
2. Transport the MV Power Station to the mounting location (see Section 4.3, page 42).
3. Set the MV Power Station down on the support surface, and attach it if necessary.
4. Adjust the height of the oil tray to the height of the MV Power Station. Secure the oil tray against floating away if necessary.
5. Unscrew the nuts from the stud bolts of the support feet for the service platforms and remove them together with the washers.
6. Guide the stud bolts of the support feet for the service platform into the working platform fittings and mount each of them with a washer and nut (width across flats: 16 mm).



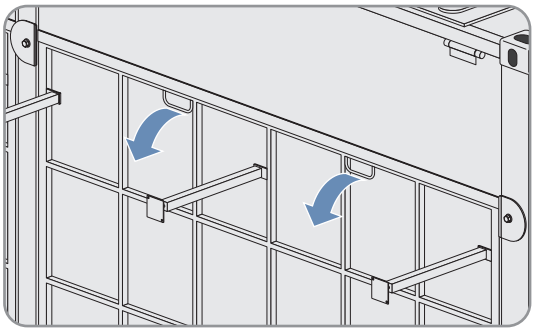
7. Remove the cable ties from the fuse of the locking mechanism.
8. Remove the locking mechanism fuse.



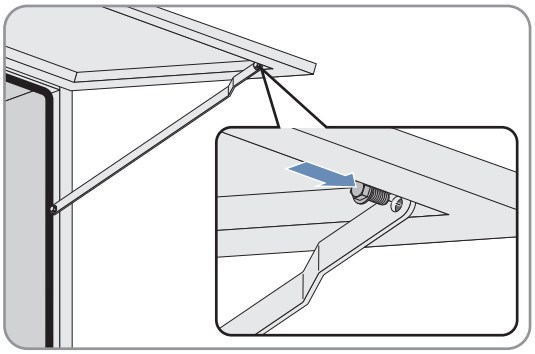
9. Turn the locking mechanism of a platform to the vertical position so that the platform can be opened. Use a box wrench (width across flats: 22 mm).



10. Have at least two people pull the service platform forwards and down. Use the handles on the service platforms.



11. After opening the protective roof, tighten the retainer on the roof and the container.



12. If the MV Power Station has been delivered in standard packaging, remove the foil from the transformer compartment.
13. If the MV Power Station has been delivered by sea, repeat steps 5 to 11 for the service platform and the protection roof in front of the MV transformer compartment.

5 Installation

5.1 Safety during Installation

⚠ DANGER

Danger to life from electric shock due to live voltage

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Wear suitable personal protective equipment for all work on the product.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 7.4, page 102).

⚠ DANGER

Danger to life from electric shock due to ground fault

If a ground fault has occurred, parts of the PV power plant that are supposedly grounded may in fact be live. Touching incorrectly grounded parts of the PV power plant results in death or serious injuries from electric shock.

- Before working on the PV power plant, ensure that no ground fault is present.
- Wear suitable personal protective equipment for all work on the device.

⚠ DANGER

Danger to life from electric shock due to live DC cables

DC cables connected to PV modules that are exposed to sunlight carry live voltage. Touching live cables results in death or serious injury due to electric shock.

- Prior to connecting the DC cables, ensure that the DC cables are voltage-free.
- Wear suitable personal protective equipment for all work on the device.

⚠ WARNING

Risk of fire due to failure to observe torque specifications on live bolted connections

Failure to follow the specified torques reduces the ampacity of live bolted connections so that the contact resistances increase. This can cause components to overheat and catch fire.

- Ensure that live bolted connections are always tightened with the exact torque specified in this document.
- When working on the device, use suitable tools only.
- Avoid repeated tightening of live bolted connections as this may result in inadmissibly high torques.

⚠ WARNING

Danger to life from electric shock when entering the PV field

Ground-fault monitoring does not provide protection from personal injury. PV modules which are grounded with ground-fault monitoring discharge voltage to ground. Entering the PV field can result in lethal electric shocks.

- Ensure that the insulation resistance of the PV field exceeds the minimum value. The minimum value of the insulation resistance is: 1 kΩ.
- Before entering the PV field, switch the PV modules to insulated operation.
- Configure the PV power plant as a closed electrical operating area.

⚠ CAUTION

Danger of falling from service platforms

Icy, moist or sand-covered service platforms may be slippery. Service personnel can be injured by slipping or falling from service platforms.

- Wear suitable personal protective equipment for all work on the product.
- Before stepping onto the service platform, ensure that there is no layer of snow, ice, sand or moisture on the platform.
- Do not keep any objects near or on the service platforms.

NOTICE

Damage to the devices due to sand, dust or moisture penetration

Sand, dust or moisture penetration can damage the devices of the MV Power Station or impair their functionality.

- Do not open any devices during a sandstorm, precipitation or when humidity exceeds 95%.
- Only perform maintenance work when the environment is dry and free of dust.
- If the installation, maintenance or commissioning process is interrupted, mount all enclosure parts and close all doors.

NOTICE

Damage to electronic components due to electrostatic discharge

Electrostatic discharge can damage or destroy electronic components.

- Observe the ESD safety regulations when working on the product.
- Wear suitable personal protective equipment for all work on the product.
- Discharge electrostatic charge by touching grounded enclosure parts or other grounded elements. Only then is it safe to touch electronic components.

NOTICE

Damage to optical fibers due to too tight bend radii

Excessive bending or kinking will damage the optical fibers.

- Observe the minimum permissible bend radii of the optical fibers.

NOTICE

Damage to the product due to non-removal of transport lock

The product is provided with a special security lock for transport to protect it from moisture. Non-removal of the transport lock can cause condensation and overheating during operation.

- Prior to installation work, ensure that all transport locks on the product are removed.

DC-side disconnection

The DC main distributions and DC subdistributions should be equipped with load-break switches or circuit breakers. Load-break switches or circuit breakers enable trouble-free DC-side disconnection of the inverter.

5.2 Installation Sequence

The sequence of installation work given in this section is recommended by SMA. It is important to begin the installation with the preparatory work and the grounding connection. Therefore, SMA recommends that you adhere to this sequence to avoid problems during installation. Some of the installation work will only need to be carried out for certain options.

Task	See
Removing the transport locks from the inverter compartment	Section 5.3.1, page 53
Removing the desiccant bag	Section 5.3.6, page 57
Removing the transport locks in the MV transformer compartment	Section 5.3.3, page 55
Removing the emergency switch transport lock*	Section 5.3.4, page 56
Working in the compartment of the medium-voltage switchgear	Section 5.3.5, page 56
Inserting the cables	Section 12.4, page 167
Grounding the station container	Section 5.4, page 58
Installing the AC connection Depending on the order option, the AC connection will be installed on the medium-voltage switchgear or the MV transformer.	Section 5.5, page 59
Installing the communication Depending on the order option, the communication will be connected in the Communit or in the inverter.	Section 5.7.1, page 64
Connecting the communication in the inverter with optical fibers	Section 5.7.2.1, page 66 or Section 5.7.2.2, page 68
Connecting the communication in the inverter with copper cables	Section 5.7.1.2, page 65
Connecting the communication in the Communit with optical fibers	Section 5.7.1.1, page 64
Connecting the communication in the Communit with copper cables	Section 5.7.1.2, page 65
Connecting cables for analog setpoints	Section 5.7.2.4, page 70
Connecting the external fast stop	Section 5.7.2.5, page 70
Connecting the remote shutdown	Section 5.7.2.6, page 71
Connecting the external insulation monitoring alert	Section 5.7.2.7, page 71

Task	See
Connecting the monitoring of the AC contactor	Section 5.7.2.8, page 71
Connecting the data cable of the Sunny String-Monitor	Section 5.7.2.9, page 72
Connecting the DC cables for option "Busbar"	Section 5.6.1, page 61
Connecting the DC cables for option "DC fuse"	Section 5.6.2, page 63
Mounting the panels	Section 12.3.1.2, page 164
Closing the base plate	Section 5.8.1, page 72

* With the order option "Country package, France"

5.3 Preparatory Work

5.3.1 Removing the Transport Locks from the Inverter Compartment

5.3.1.1 Loosening the Tie-Down Straps

⚠ CAUTION

Risk of injury when releasing the tie-down straps

Since there is tension on the tie-down straps, there is a risk of whiplash when they are released. This can result in cuts or crushing of limbs.

- Ensure that the tie-down straps cannot whiplash.
- Observe all manufacturer instructions on handling the tie-down straps.

Procedure:

- Loosen the tie-down straps.

5.3.1.2 Removing the Air Cushion

In the MV Power Station with two inverters, the air cushion between the inverters serves as protection during transport.

Procedure:

1. Open the inverter compartment (see Section 12.1, page 159).
2. Remove the air cushion.
3. Close the inverter compartment (see Section 12.1, page 159).

5.3.1.3 Opening the Drain Orifices in the Inverter Compartment

With the order option "Sea freight", the drain orifices in the inverter compartment are closed with plugs.

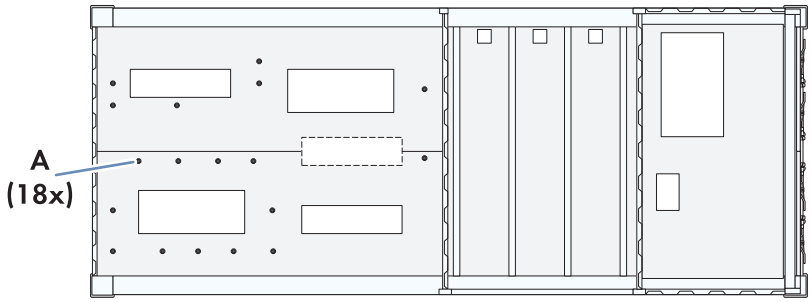


Figure 30: Position of the drain orifices

Position	Designation
A	Drain orifice

Procedure:

1. Open the inverter compartment (see Section 12.1, page 159).
2. Disassemble the panels of the inverters (see Section 12.3.1.2, page 164).
3. Remove the plugs from the drain orifices in the floor of the station container.
4. Close the inverter compartment (see Section 12.1, page 159).

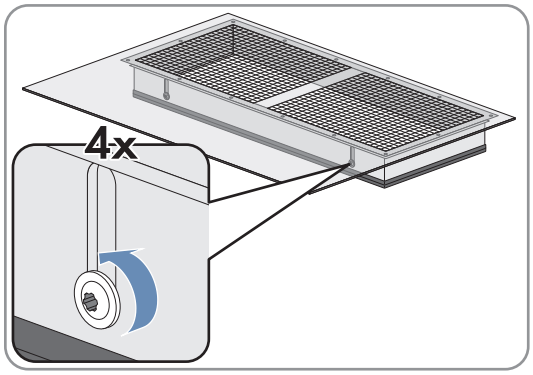
5.3.2 Mounting the Exhaust Duct under the Inverters

If the MV Power Station with two inverters is delivered via sea freight, the exhaust ducts below the inverters must be mounted prior to installation.

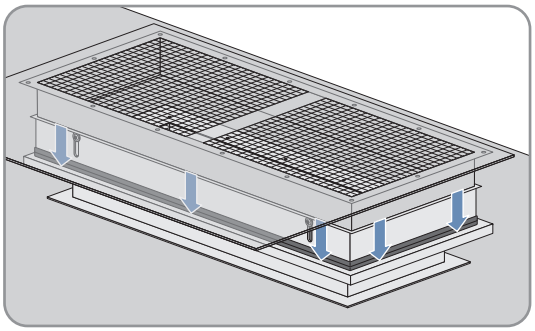
The exhaust duct is positioned on the bottom side of the ventilation plate. The warm exhaust air from the inverters is evacuated through the exhaust ducts under the MV Power Station.

Procedure:

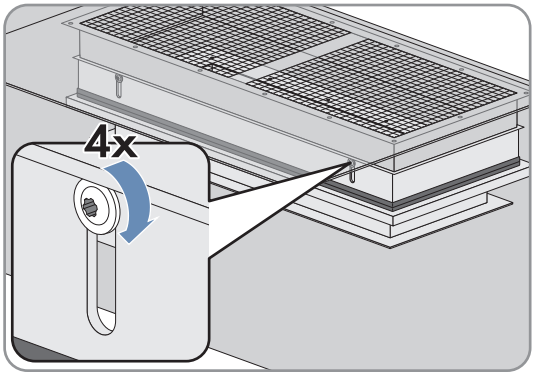
1. Open the inverter compartment (see Section 12.1, page 159).
2. Disassemble the panels on the inverter cabinet (see Section 12.3.1.2, page 164).
3. On the front side of the inverter, remove the ventilation plate from the inverter.
4. Remove the screws of the cover plate under the inverter.
5. Remove the cover plate from the station container. The cover plate and the screws are no longer needed.
6. Push the ventilation plate into the inverter.
7. Loosen the four screws on the exhaust duct on the bottom side of the ventilation plate.



8. Pull down the exhaust duct on both sides equally to the floor of the station.



9. Tighten the four screws on the exhaust duct.



10. Mount the panels on the inverter cabinet (see Section 12.3.1.2, page 164).
11. Close the inverter compartment (see Section 12.1, page 159).

5.3.3 Removing the Transport Lock from the MV Transformer Compartment

In the compartment of the MV transformer, the tie-down straps must be removed and the drain orifices must be opened.

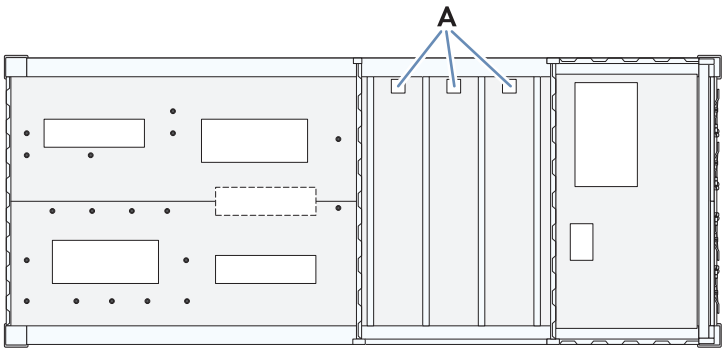


Figure 31: Position of the drain orifices in the MV transformer compartment

Position	Designation
A	Drain orifice

⚠ CAUTION

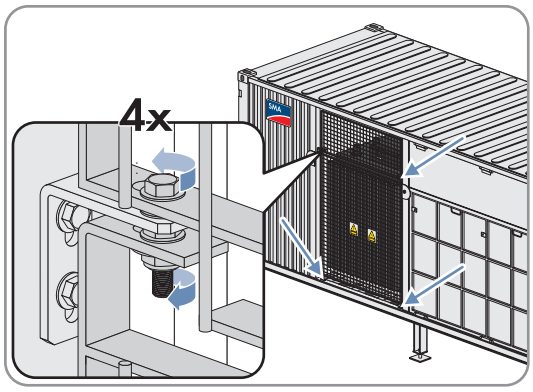
Risk of injury when releasing the tie-down straps

Since there is tension on the tie-down straps, there is a risk of whiplash when they are released. This can result in cuts or crushing of limbs.

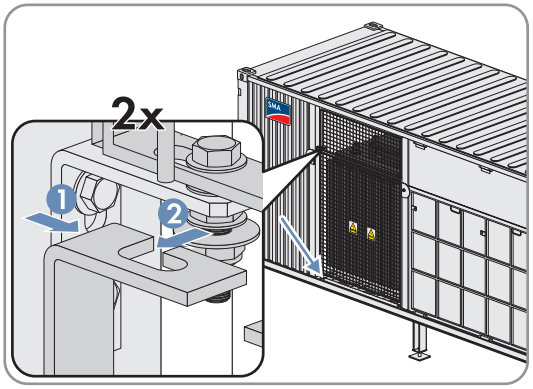
- Ensure that the tie-down straps cannot whiplash.
- Observe all manufacturer instructions on handling the tie-down straps.

Procedure:

1. Slightly loosen the screws of the lattice door in front of the MV transformer.



2. Unlock and open the lattice door.

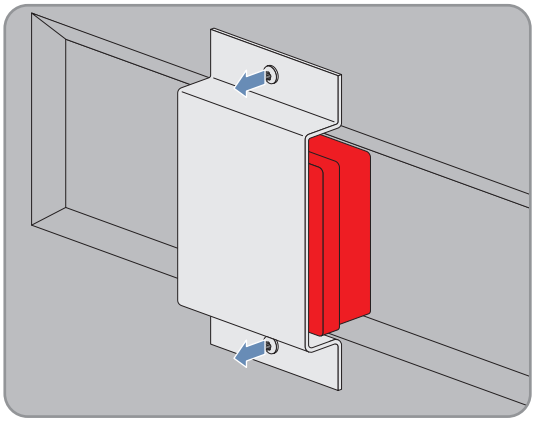


3. Loosen the four tie-down straps.
4. Loosen the screws on the drain orifices in front of the MV transformer and remove the covers.
5. Close the lattice door in front of the MV transformer again and fasten the screws.

5.3.4 Removing the Emergency Switch Transport Lock

With the order option "Country package, France", the emergency switch transport lock must be removed.

- Remove the screws on the transport lock and remove the transport lock.



5.3.5 Working in the Compartment of the Medium-Voltage Switchgear

Required mounting material (included in the scope of delivery):

☐ Base plate for cable entry

⚠ CAUTION

Risk of injury when releasing the tie-down straps

Since there is tension on the tie-down straps, there is a risk of whiplash when they are released. This can result in cuts or crushing of limbs.

- Ensure that the tie-down straps cannot whiplash.
- Observe all manufacturer instructions on handling the tie-down straps.

Procedure:

1. Open the medium-voltage switchgear compartment (see Section 12.1, page 159).
2. Set up the service platform of the medium-voltage switchgear (see Section 12.2, page 162).
3. Loosen the tie-down straps on the medium-voltage switchgear.
4. When the MV Power Station was delivered by sea, remove the foil from the ventilation openings on the doors in the compartment of the medium-voltage switchgear:
   - Remove the grids on the inside of the doors.
   - Remove the foil from the ventilation openings.
   - Mount the grids on the inside of the doors.
5. When the MV Power Station was delivered by sea, mount the base plate for cable entry:
   - Disassemble the panels on the base of the medium-voltage switchgear (see Section 12.3.2.1, page 166).
   - Remove the screws of the cover plate under the medium-voltage switchgear.
   - Remove the cover plate from the medium-voltage switchgear. The cover plate is no longer needed.
   - Fasten the base plate for the cable entry above the opening for the cable entry.
   - Mount the panels on the base of the medium-voltage switchgear (see Section 12.3.2.1, page 166).
6. Flip the working platform of the medium-voltage switchgear and lock it.
7. Close the medium-voltage switchgear compartment (see Section 12.1, page 159).

5.3.6 Removing the Desiccant Bags

5.3.6.1 Removing the Desiccant Bag from the Station Container

Desiccant bags are included with sea freight orders. The desiccant bags absorb moisture formed during transport.

Procedure:

1. Open the medium-voltage switchgear compartment (see Section 12.1, page 159).
2. Remove the desiccant bags from the station container. Remove the cable ties around the desiccant bags using diagonal cutting pliers. The desiccant bags are to be found at the following positions:
   - Between the inverters
   - In the compartment of the MV transformer
   - In the compartment of the medium-voltage switchgear
3. Close the medium-voltage switchgear compartment (see Section 12.1, page 159).

5.3.6.2 Replacing the Desiccant Bag in the Inverter

i Desiccant bag in the inverter cabinet

The desiccant bag in the inverter cabinet protects the electronic components from moisture. The desiccant bag must be replaced by a new desiccant bag included in the scope of delivery one day before commissioning.

Procedure:

1. Remove and dispose of the desiccant bag located under the inverter bridges.
2. Remove the desiccant bag included in the scope of delivery from the foil and position it under the inverter bridges.

5.3.7 Connecting the Battery to the Control Device of the Cascade Control

In order option "Cascade control", the battery of type 12 V to 24 Ah is located in the medium-voltage compartment included in the scope of delivery for the MV Power Station. The battery must be connected to the control device.

Do not touch the battery terminals.

The battery for the control device is charged upon delivery.

- When transporting the battery, do not touch the terminals.

The battery must be charged when switching on the control device

If the battery of the control device is empty, the control device and thus the medium voltage of the MV Power Station cannot be reconnected.

- Connect the battery to the control device at maximum two hours prior to final connection of the medium voltage.

Requirement:

☐ The supply voltage of the control device must be present.

Procedure:

1. Unpack the battery.
2. Open the enclosure of the control device.
3. Position the battery in the enclosure and connect it (see documentation for the control device).

5.4 Installing the Grounding on the Station Container

Equipotential bonding of the oil tray

- The supplied oil tray must be connected to the grounding busbar of the MV Power Station.

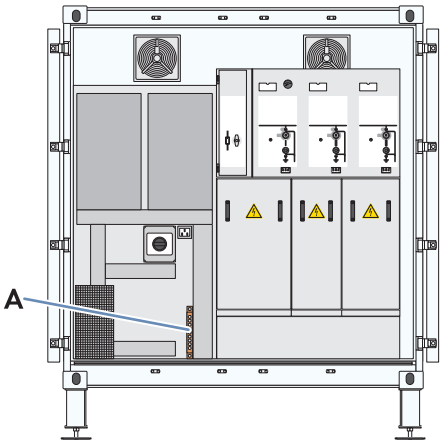


Figure 32: Position of the grounding to the station container

Position	Designation
A	Grounding busbar

Requirements:

☐ The cables must be inserted through the base plate (see Section 12.4, page 167). It is recommended using plastic tubes without grooves in order to allow easier insertion of the cables.

Cable requirements:

☐ Cable cross-section: minimum 1 x 50 mm^2, maximum 2 x 95 mm^2

☐ Cable cross-section for the grounding of the oil tray: 50 mm^2

☐ Use copper or aluminum cables only.

Required mounting material (included in the scope of delivery):

☐ Screws

☐ Spring washers

☐ Fender washers

☐ Nuts

Additionally required mounting material (not included in the scope of delivery):

☐ Ground electrode in accordance with the grounding concept of the PV system

☐ Clean cloth

☐ Ethanol cleaning agent

☐ Terminal lugs suitable for the selected cable cross-section

☐ Non-woven abrasive

Procedure:

1. Install the ground electrodes in accordance with the applicable regulations.
2. Ensure that the required grounding resistance is achieved.
3. If insulated grounding cables are used, strip off the insulation.
4. Fit the grounding cables with terminal lugs.
5. Clean the contact surfaces of the terminal lugs with a clean cloth and ethanol cleaning agent.
6. Clean the contact surfaces with the non-woven abrasive until they have a light metallic sheen. Ensure that the coated contact surfaces are not damaged.
7. Remove metal dust using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces again after cleaning.
8. Connect the grounding cable for grounding the oil tray to the grounding bolt of the oil tray (M13, torque: 15 Nm).
9. Connect the grounding cable for grounding the oil tray to the grounding busbar of the MV Power Station.
10. Connect the grounding cable for the ground electrode to the grounding busbar of the MV Power Station.
11. Connect the grounding cable for the ground electrode to the ground electrode.

5.5 Installing the AC Connection

Depending on the order option, the AC connection must be installed on the medium-voltage switchgear or the MV transformer. You must select the relevant section.

5.5.1 Installing the AC Connection on the Medium-Voltage Switchgear

Requirements:

☐ The cables must be inserted through the base plate (see Section 12.4, page 167). It is recommended using plastic tubes without grooves in order to allow easier insertion of the cables.

Procedure:

- Connect the cables to the medium-voltage switchgear (see documentation for the medium-voltage switchgear).

5.5.2 Installing the AC Connection on the MV Transformer

If the medium-voltage switchgear was not ordered with the MV Power Station, the AC cables must be connected to the MV transformer. The AC cables must be inserted through the base plate of the medium-voltage switchgear and through the partition to the MV transformer. It is recommended using plastic tubes without grooves in order to allow easier insertion of the cables.

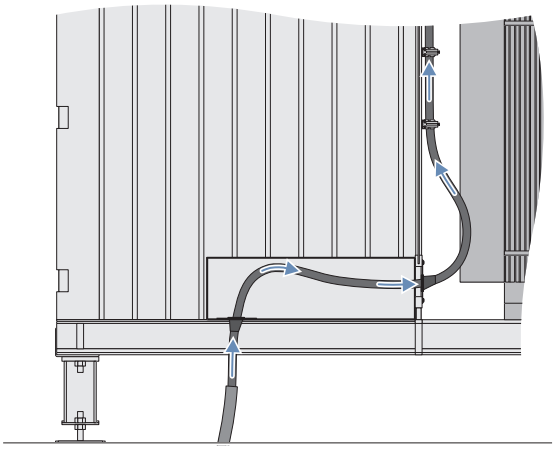


Figure 33: Cable route for connection to the MV transformer

Requirement:

☐ The AC cables must be correctly inserted and attached.

Procedure:

- Connect the AC cables to the MV transformer (see MV transformer documentation).

5.6 Installing the DC Connection

5.6.1 Connecting the DC Cable to the Busbar

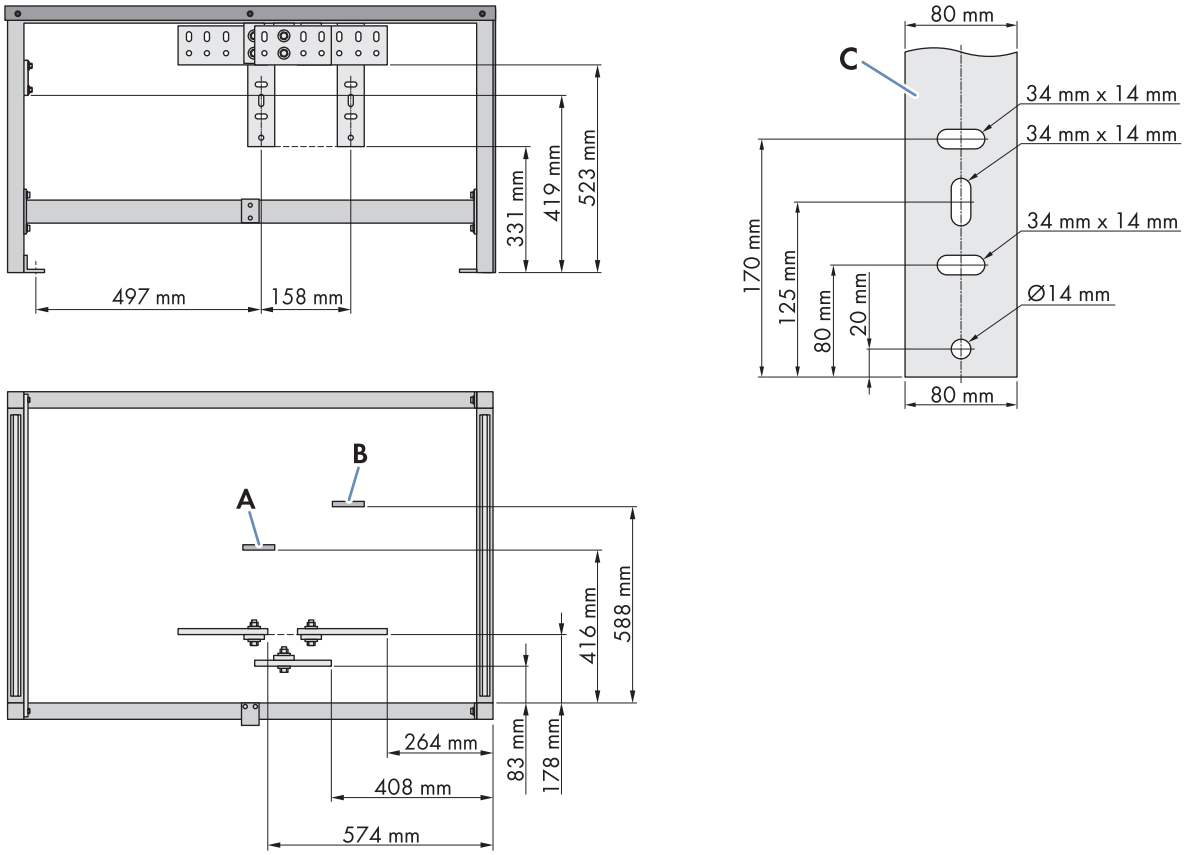


Figure 34: Dimensions of the DC busbar (example)

Position	Designation
A	Connection area DC+
B	Connection area DC–
C	DC connection bracket with dimensions

Terminal lug requirements:

- ☐ Use tin-plated terminal lugs only.
- ☐ For the connection, only the supplied screws, washers and nuts must be used.
- ☐ The terminal lugs must be designed according to the temperature. Temperature: +95°C
- ☐ The width of the terminal lugs must exceed the washer diameter. Washer diameter: 32 mm. This will ensure that the defined torques are effective over the whole surface.

Cable requirements:

- ☐ The DC cables must be designed for the maximum PV voltage and must have double or reinforced insulation.
- ☐ No more than two cables must be connected to each DC terminal.
- ☐ Use copper or aluminum cables only.
- ☐ Maximum cable cross-section: 400 mm².
- ☐ Terminal lugs: M12

Torques of the power connections:

Type of terminal lug	Torque
Tin-plated aluminum terminal lug on copper bar	37 Nm
Tin-plated copper terminal lug on copper bar	60 Nm

Additionally required mounting material (not included in the scope of delivery):

☐ Clean cloth

☐ Ethanol cleaning agent

Procedure:

1. Disassemble the panels (see Section 12.3.1.2, page 164).
2. Disassemble the protective covers (see Section 12.3.1.1, page 163).
3. Prepare the cables for connection (see Section 12.5, page 172).
4. Clean the tin-plated contact surfaces in the connection area with the non-woven abrasive until they have a light metallic sheen.
5. Clean all contact surfaces in the connection area using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces after cleaning.
6. Connect the cables in accordance with the circuit diagram. Only use the screws, nuts and washers included in the scope of delivery and make sure that the screw heads always point forwards.
7. Secure the cables on the cable support rail. This will prevent the cable from being pulled out inadvertently.
8. Mount the protective covers (see Section 12.3.1.1, page 163).
9. Mount the panels (see Section 12.3.1.2, page 164).

5.6.2 Connecting the DC Cables to the Connection Brackets

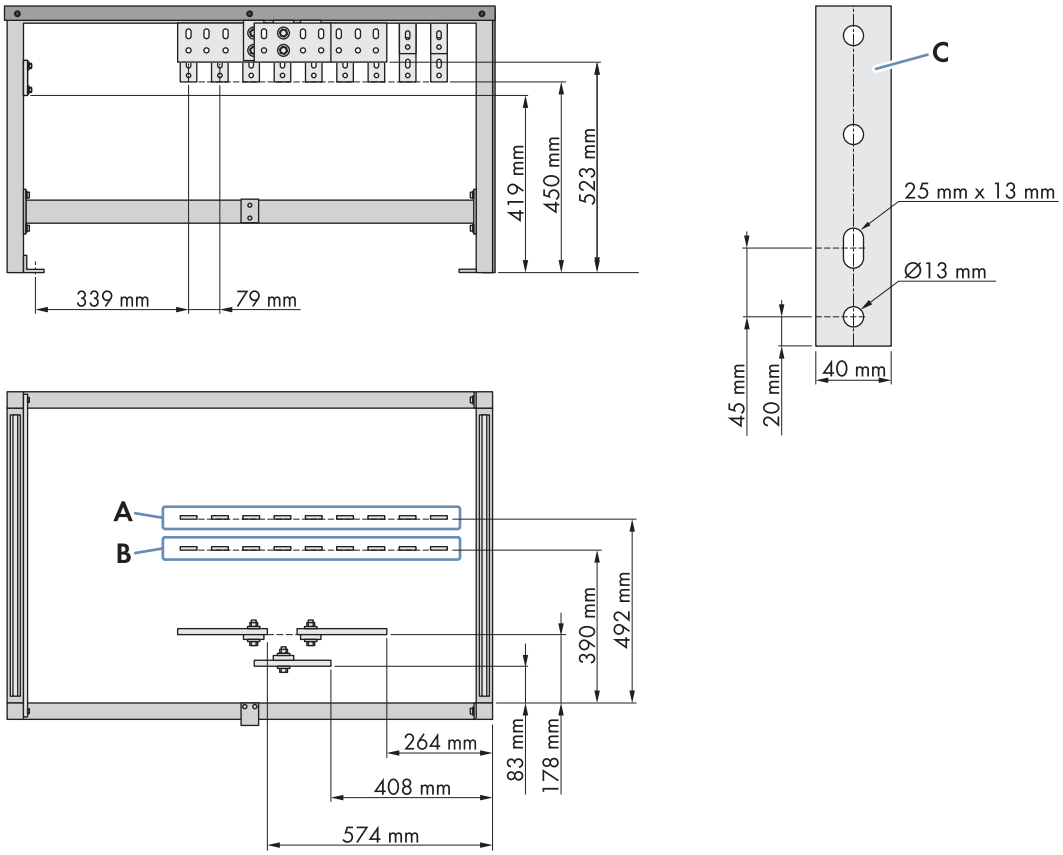


Figure 35: Connection area for DC fuses (example)

Position	Designation
A	Connection area DC–
B	Connection area DC+
C	DC connection bracket with dimensions

Terminal lug requirements:

- ☐ Use tin-plated terminal lugs only.
- ☐ For the connection, only the supplied screws, washers and nuts must be used.
- ☐ The terminal lugs must be designed according to the temperature. Temperature: +95°C
- ☐ The width of the terminal lugs must exceed the washer diameter. Washer diameter: 32 mm. This will ensure that the defined torques are effective over the whole surface.

Cable requirements:

- ☐ The DC cables must be designed for the maximum PV voltage and must have double or reinforced insulation.
- ☐ No more than two cables must be connected to each DC terminal.
- ☐ Use copper or aluminum cables only.
- ☐ Maximum cable cross-section: 400 mm².
- ☐ Terminal lugs: M12

Torques of the power connections:

Type of terminal lug	Torque
Tin-plated aluminum or copper terminal lug on aluminum bar	37 Nm

Additionally required mounting material (not included in the scope of delivery):

☐ Clean cloth

☐ Ethanol cleaning agent

Requirement:

☐ The reduction of DC input currents must be complied with (see Section 16.3.2, page 260).

Procedure:

1. Disassemble the panels (see Section 12.3.1.2, page 164).
2. Disassemble the protective covers (see Section 12.3.1.1, page 163).
3. Prepare the cables for connection (see Section 12.5, page 172).
4. Clean the tin-plated contact surfaces in the connection area with the non-woven abrasive until they have a light metallic sheen.
5. Clean all contact surfaces in the connection area using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces after cleaning.
6. Connect the cables in accordance with the circuit diagram. Only use the screws, nuts and washers included in the scope of delivery and make sure that the screw heads always point forwards.
7. Secure the cables on the cable support rail. This will prevent the cable from being pulled out inadvertently.
8. Mount the protective covers (see Section 12.3.1.1, page 163).
9. Mount the panels (see Section 12.3.1.2, page 164).

5.7 Connecting the Cables for Communication, Control, Supply Voltage and Monitoring

Depending on the order option and the circuitry of the network devices, e.g., in ring topology, the network devices will be connected both in the Communit and in the inverter. Connect the communication devices in accordance with the communication plan of the PV system. The communication plan is normally created in the course of system planning.

5.7.1 Connecting the Cables in the Communit

5.7.1.1 Connecting Optical Fibers

Additionally required material (not included in the scope of delivery):

☐ Optical fiber pigtails of the appropriate optical fiber type with subscriber connectors.

Requirements:

☐ The patch panel and the network switches must be suitable for the selected type of optical fiber.

☐ The optical fibers must be correctly inserted through the base plates of the MV Power Station and in the Communit (see Section 12.4, page 167).

⚠ CAUTION

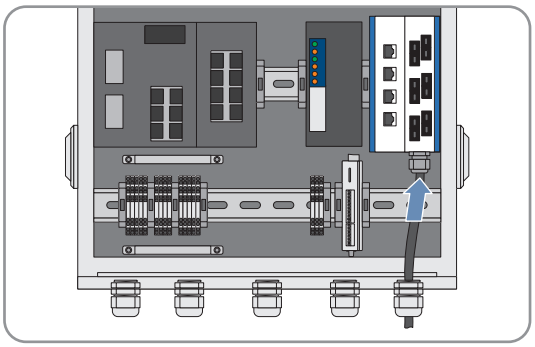
Damage to eyes and skin due to visible and invisible laser radiation

The product contains class 1 LED or laser components in accordance with IEC 60825-1 (2003). The laser beam appears at the end of the optical fiber. Incorrect handling with laser beams can result in damage to eyes and skin.

- Do not look into the laser beam.
- Do not look at the laser beam using optical instruments.
- Do not point the laser beam at persons.

Procedure:

1. Insert the optical fibers into the patch panel from below and splice using optical fiber pigtails (see the patch panel documentation). Observe the maximum permissible tension and the minimum permissible bend radii of the optical fibers.



2. Connect the patch panel to the network switch using the optical fiber patch cables included in the delivery (bend radius: 100 mm). Observe the send and receive directions of the optical fiber nodes.

5.7.1.2 Connecting the Network Cables

Network cable requirements:

☐ The network cables must be shielded and pair-twisted.

☐ The network cables must be of at least category 5 (CAT 5).

☐ Maximum cable length: 100 m

Requirement:

☐ The network cables must be correctly inserted through the base plates of the MV Power Station and in the Communit (see Section 12.4, page 167).

Procedure:

- Connect the network cables to the network terminals in accordance with the circuit diagram.

5.7.2 Connecting the Cable in the Inverter

5.7.2.1 Connecting Optical Fibers with Subscriber Connector

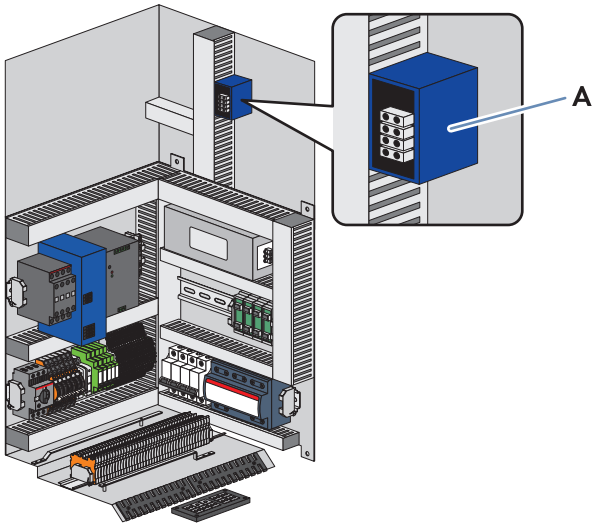


Figure 36: Position of the splice box

Position	Designation
A	Splice box

Additionally required mounting material (not included in the scope of delivery):

☐ 2 subscriber connectors

NOTICE

Damage to optical fibers due to too tight bend radii

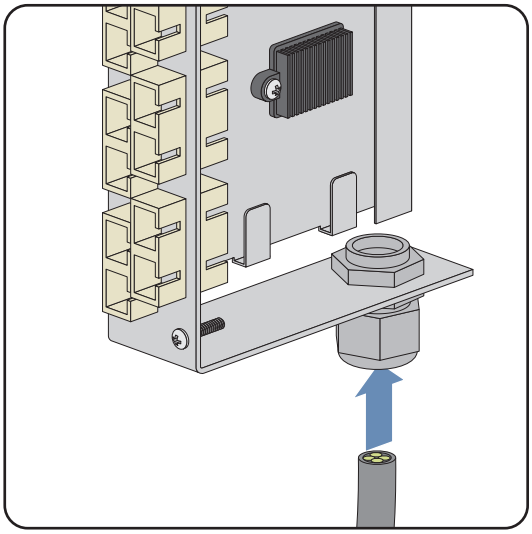
Excessive bending or kinking will damage the optical fibers.

- Observe the minimum permissible bend radii of the optical fibers.

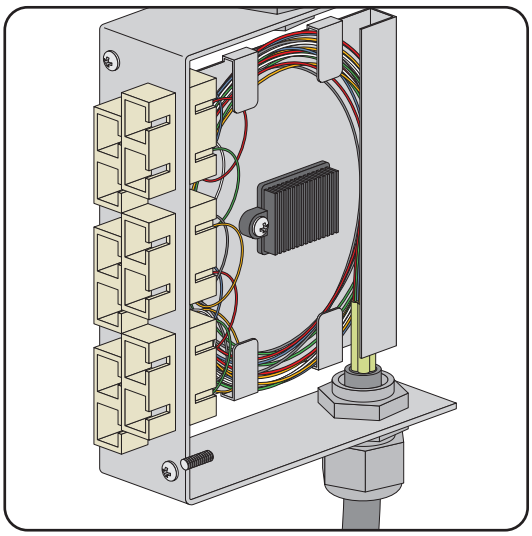
Procedure:

1. Disassemble the panels (see Section 12.3.1.2, page 164).
2. Insert the optical fibers in the inverter (see Section 12.4.3, page 171).
3. Remove the splice box from the top-hat rail:
4. Open the enclosure of the splice box.

5. Insert the optical fibers from below through the cable gland into the splice box.



6. Mount the subscriber connectors on the optical fibers.
7. Plug the subscriber connectors into the SC-P plugs in the splice box.
8. Coil the residual glass fiber in the fiber reservoir. Observe the permissible bend radii.



9. Screw on the enclosure of the splice box.
10. Reinstall the splice box on the top-hat rail.
11. Attach the optical fibers to the cable support rail using a cable tie. This ensures that the optical fibers cannot be pulled out inadvertently.
12. Mount the panels (see Section 12.3.1.2, page 164).

5.7.2.2 Connecting Optical Fibers via Optical Fiber Pigtail

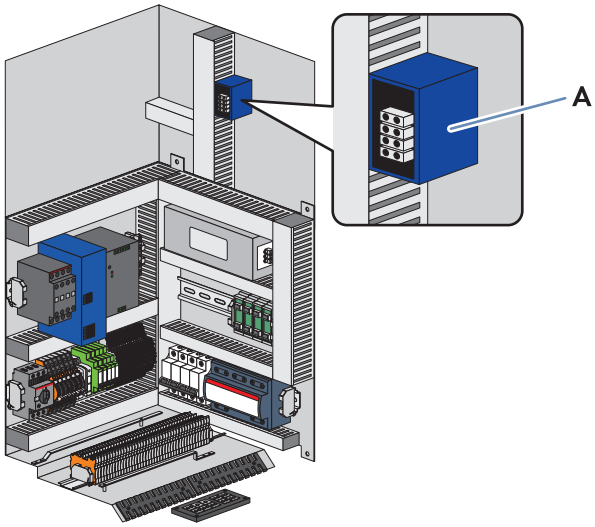


Figure 37: Position of the splice box

Position	Designation
A	Splice box

Optical fiber requirements:

☐ The optical fiber cables must be equipped with a 50 µm multi-mode optical fiber.

☐ The optical fibers must be fitted with a subscriber connector.

NOTICE

Damage to optical fibers due to too tight bend radii

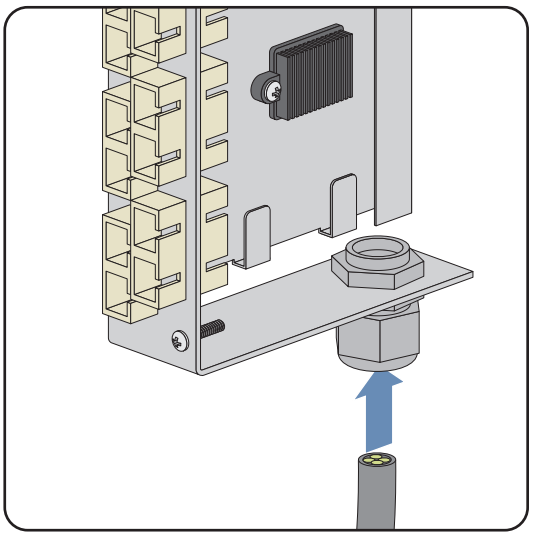
Excessive bending or kinking will damage the optical fibers.

- Observe the minimum permissible bend radii of the optical fibers.

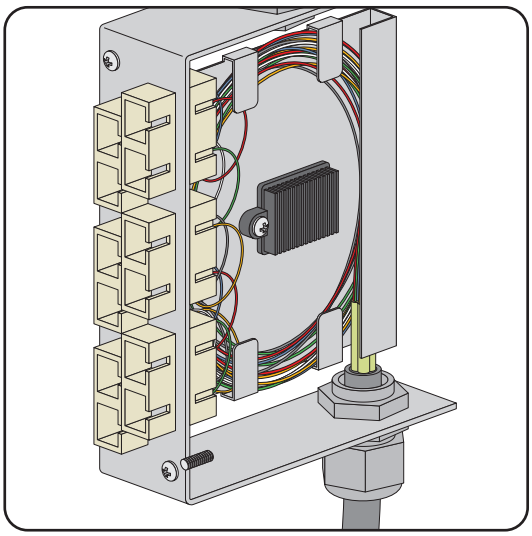
Procedure:

1. Disassemble the panels (see Section 12.3.1.2, page 164).
2. Insert the optical fibers in the inverter (see Section 12.4.3, page 171).
3. Remove the splice box from the top-hat rail:
4. Open the enclosure of the splice box.

5. Insert the optical fibers from below through the cable gland into the splice box.



6. Splice the optical fibers with the optical fiber pigtails in the splice box.
7. Plug the subscriber connectors into the SC-P plugs in the splice box.
8. Coil the residual glass fiber in the fiber reservoir. Observe the permissible bend radii.



9. Screw on the enclosure of the splice box.
10. Reinstall the splice box on the top-hat rail.
11. Attach the optical fibers to the cable support rail using a cable tie. This ensures that the optical fibers cannot be pulled out inadvertently.
12. Mount the panels (see Section 12.3.1.2, page 164).

5.7.2.3 Connecting the Network Cables

Network cable requirements:

- ☐ The network cables must be shielded and pair-twisted.
- ☐ The network cables must be of at least category 5 (CAT 5).
- ☐ Maximum cable length: 100 m

Procedure:

1. Disassemble the panels (see Section 12.3.1.2, page 164).
2. Insert the network cables (see Section 12.4.3, page 171).
3. Insert the network cables into the network ports.

4. Attach the network cables to the cable support rail using a cable tie. This will prevent the network cables from being pulled out inadvertently.
5. Mount the panels (see Section 12.3.1.2, page 164).

5.7.2.4 Connecting Cables for Analog Setpoints

If the setpoints for active power limitation and reactive power control are not transmitted via the network, there are terminals in the inverter for connecting external setpoints. The inverter processes standard analog signals from 4.0 mA to 20.0 mA.

Cable requirement:

☐ The cable used must be shielded.

Procedure:

1. Disassemble the panels (see Section 12.3.1.2, page 164).
2. Insert the cables (see Section 12.4.3, page 171).
3. Connect the cables in accordance with the circuit diagram (see Section 12.6, page 175).
4. Secure the cables on the cable support rail. This will prevent the cables from being pulled out inadvertently.
5. Mount the panels (see Section 12.3.1.2, page 164).

5.7.2.5 Connecting the Cable for the External Fast Stop

If required, you can connect an external fast stop in accordance with the circuit diagram. The fast stop can be operated by means of an internal or external supply voltage.

i Fast stop input already assigned for order option "AC contactor"

If the MV Power Station is delivered with order option "AC contactor", the fast stop input for the voltage and frequency monitoring relay is already assigned. Thus, connecting an external switch is not possible.

i Shortfall of external supply voltage

If there is an external supply voltage between 18.5 V to 24.0 V, the inverter will continue to operate in its current operating state. If the external supply voltage falls below 18.5 V, the inverter switches from the current operating state to the operating state "Stop". If the temperature inside the inverter exceeds the temperature limit, a supply voltage of 20.0 V to 24.0 V must be present to continue operating the inverter in its current operating state. Temperature limit: +60°C

- Ensure that the external supply voltage is between 20.0 V and 24.0 V.

Cable requirement:

☐ The cable used must be shielded.

Additional cable requirements for internal supply voltage:

☐ Maximum cable length with cable cross-section: 130 m / 2.5 mm²

☐ Maximum cable length with cable cross-section: 80 m / 1.5 mm²

Requirements:

☐ A switch must be used that can interrupt the supply voltage.

Procedure:

1. Disassemble the panels (see Section 12.3.1.2, page 164).
2. Insert the cables (see Section 12.4.3, page 171).
3. Connect the cables in accordance with the circuit diagram (see Section 12.6, page 175).

4. Secure the cables on the cable support rail. This will prevent the cables from being pulled out inadvertently.
5. Mount the panels (see Section 12.3.1.2, page 164).

5.7.2.6 Connecting the Cable for Remote Shutdown

The remote shutdown enables the inverter to be switched off from a distance, e.g. from a control room. The function of the remote shutdown is similar to the stop function of the key switch.

i Shortfall of external supply voltage

If there is an external supply voltage between 18.5 V to 24.0 V, the inverter will continue to operate in its current operating state. If the external supply voltage falls below 18.5 V, the inverter switches from the current operating state to the operating state "Stop". If the temperature inside the inverter exceeds the temperature limit, a supply voltage of 20.0 V to 24.0 V must be present to continue operating the inverter in its current operating state. Temperature limit: +60°C

- Ensure that the external supply voltage is between 20.0 V and 24.0 V.

Procedure:

1. Disassemble the panels (see Section 12.3.1.2, page 164).
2. Insert the cables (see Section 12.4.3, page 171).
3. Connect the cables in accordance with the circuit diagram (see Section 12.6, page 175).
4. Secure the cables on the cable support rail. This will prevent the cables from being pulled out inadvertently.
5. Mount the panels (see Section 12.3.1.2, page 164).

5.7.2.7 Connecting the Cable for the Status Report of the Insulation Monitoring

i Status report

The switching status can be queried via a contact. For details of terminal assignment, see circuit diagram.

Requirements:

☐ The connected load must operate with a voltage of 230 V_{AC} or 24 V_{DC}.

☐ The connected load must draw a current of 10 mA to 6 A.

Procedure:

1. Disassemble the panels (see Section 12.3.1.2, page 164).
2. Insert the cables (see Section 12.4.3, page 171).
3. Connect the cables in accordance with the circuit diagram (see Section 12.6, page 175).
4. Secure the cables on the cable support rail. This will prevent the cables from being pulled out inadvertently.
5. Mount the panels (see Section 12.3.1.2, page 164).

5.7.2.8 Connecting the Cable for the Status Report of the AC Contactor Monitoring

i Status report

The switching status can be queried via a contact. For details of terminal assignment, see circuit diagram.

Requirements:

☐ The connected load must operate with a voltage of 230 V_{AC} or 24 V_{DC}.

☐ The connected load must draw a current of 10 mA to 6 A.

Procedure:

1. Disassemble the panels (see Section 12.3.1.2, page 164).
2. Insert the cables (see Section 12.4.3, page 171).

3. Connect the cables in accordance with the circuit diagram (see Section 12.6, page 175).
4. Secure the cables on the cable support rail. This will prevent the cables from being pulled out inadvertently.
5. Mount the panels (see Section 12.3.1.2, page 164).

5.7.2.9 Connecting the Data Cable of the Sunny String-Monitor

For an optimum supply voltage, it is recommended to connect two insulated conductors each in the terminals of the supply voltage and of the grounding.

Cable requirements:

☐ The supply voltage and the communication connection must be combined in one cable.

☐ The cable used must be shielded.

☐ Recommended cable type: Li2YCYv (TP) 4 x 2 x 0.5 mm².

Procedure:

1. Disassemble the panels (see Section 12.3.1.2, page 164).
2. Insert the cables (see Section 12.4.3, page 171).
3. Connect the cables in accordance with the circuit diagram (see Section 12.6, page 175).
4. Secure the cables on the cable support rail. This will prevent the cables from being pulled out inadvertently.
5. Mount the panels (see Section 12.3.1.2, page 164).

5.8 Completion Work

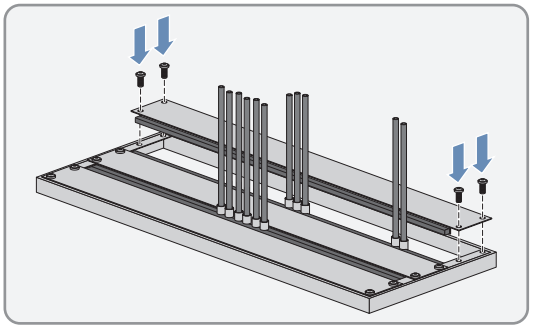
5.8.1 Closing the Base Plates on the Inverter

Requirement:

☐ All cables must be inserted in and connected to the MV Power Station.

Procedure:

1. Insert the base plates under the inverter. The base plates must be aligned as close as possible to each other.
2. Tighten the base plates. Ensure that the enclosure openings close tightly.



6 Commissioning

6.1 Safety during Commissioning

⚠ DANGER

Danger to life from electric shock due to live voltage

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Wear suitable personal protective equipment for all work on the product.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 7.4, page 102).

⚠ DANGER

Danger to life from electric shock due to ground fault

If a ground fault has occurred, parts of the PV power plant that are supposedly grounded may in fact be live. Touching incorrectly grounded parts of the PV power plant results in death or serious injuries from electric shock.

- Before working on the PV power plant, ensure that no ground fault is present.
- Wear suitable personal protective equipment for all work on the device.

⚠ WARNING

Danger to life due to arc fault caused by fault in the medium-voltage switchgear

If there is a fault in the medium-voltage switchgear, arc faults may occur during operation of the product which can result in death or serious injuries. If arc faults occur in the medium-voltage switchgear, the pressure evacuates under the compartment of the medium-voltage switchgear.

- Only perform work on the medium-voltage switchgear when it is in a voltage-free state.
- Only perform switching operations on the medium-voltage switchgear from the service platform.
- Do not touch or access the roof of the medium-voltage switchgear when medium voltage is connected.
- When switching operations are performed, all persons that are not on the service platform have to keep a safe distance from the product.
- All work and switching operations on the medium-voltage switchgear must only be performed by qualified persons wearing adequate personal protective equipment.

NOTICE

Damage to the devices due to sand, dust or moisture penetration

Sand, dust or moisture penetration can damage the devices of the MV Power Station or impair their functionality.

- Do not open any devices during a sandstorm, precipitation or when humidity exceeds 95%.
- Only perform maintenance work when the environment is dry and free of dust.
- If the installation, maintenance or commissioning process is interrupted, mount all enclosure parts and close all doors.

Connect and disconnect the AC voltage of the MV transformer

Only a duly authorized person is allowed to connect and disconnect the AC voltage of the MV transformer.

Statutory warranty and guarantee claims

Statutory warranty or guarantee claims can only be asserted if commissioning was carried out by SMA Solar Technology AG or providing that the fully completed and signed "Commissioning Report for MV Power Station" is on file at SMA Solar Technology AG.

6.2 Requirements for Commissioning

General requirements:

- ☐ None of the devices must display any damage.
- ☐ All devices must be correctly installed.
- ☐ All devices must be properly grounded.
- ☐ All transport locks and desiccant bags must be removed.
- ☐ The service platforms must be installed.
- ☐ The protection roofs must be fully extended.
- ☐ All devices must be properly closed and sealed.
- ☐ All doors and locks must function properly.
- ☐ All labels and signs must be in place.
- ☐ All cables must be correctly routed and connected to the MV Power Station.

DC side:

- ☐ The PV array must be checked.
- ☐ All cables of the PV array must be correctly connected to the Sunny String-Monitors.
- ☐ All cables of the Sunny String-Monitors must be correctly connected to the inverters.
- ☐ The polarity of the strings must be checked.
- ☐ The DC voltages must be checked.
- ☐ An insulation measurement must be carried out and recorded.
- ☐ At least 50% of the PV modules of the entire PV system must be installed and connected to the inverter. The minimum power for commissioning may deviate depending on the country. Please contact your project manager for the exact power value.

AC side:

- ☐ The AC circuit breaker on the inverter must be opened.
- ☐ The MV transformer must be connected to the utility grid.
- ☐ The MV transformer must not have any oil leaks.
- ☐ The pressure gauge for the SF6 gas on the medium-voltage switchgear gas must be in the green range.
- ☐ The accessories for the medium-voltage switchgear must be available.

Communication:

- ☐ Communication connections and the supply voltage must be connected and checked.

Documentation:

- ☐ All documentation must be available.
- ☐ SMA Solar Technology AG must have access to the safety documentation for the construction site.
- ☐ All system documentation such as cabling diagrams must be present.

6.3 Visual Inspection and Mechanical Test

6.3.1 Sequence for Visual Inspection and Mechanical Test

Procedure		See
1.	Ensure that the minimum clearances are complied with.	Technical Information "Information on Transportation and Installation of the MV Power Station"
2.	Ensure that the grounding busbar has been professionally connected to the external grounding system.	Section 6.3.2.1, page 75
3.	Ensure that the cables for communication, control, supply voltage and monitoring are correctly connected.	Section 6.3.2.3, page 76
4.	Ensure that the high-current contacts made on the installation site are correctly connected.	Section 6.3.2.4, page 76
5.	Ensure that the high-current contacts made at the factory are correctly connected.	Section 6.3.2.2, page 76
6.	Ensure that the connection busbars do not show any discoloration. If the connection busbars show any discoloration, contact the Service.	(see Section 17 "Contact", page 264)
7.	Ensure that the settings of the switching units are made correctly.	Section 6.3.3.1, page 77
8.	Ensure that all connectors are correctly connected.	Section 6.3.3.2, page 77

6.3.2 MV Power Station

6.3.2.1 Checking the Grounding

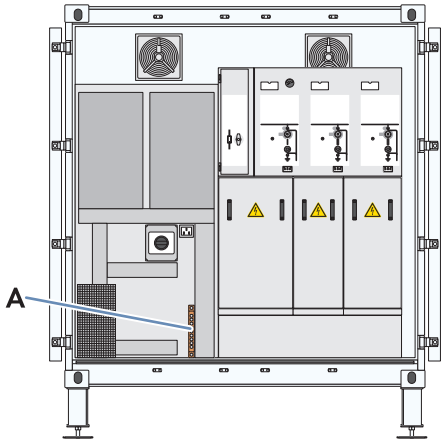


Figure 38: Grounding of the station container

Position	Designation
A	Grounding busbar

Procedure:

1. Ensure that all metal devices of the MV Power Station have been professionally connected to the grounding busbar (see circuit diagram of the MV Power Station).
2. Ensure that the grounding busbar has been professionally connected to the external grounding system.

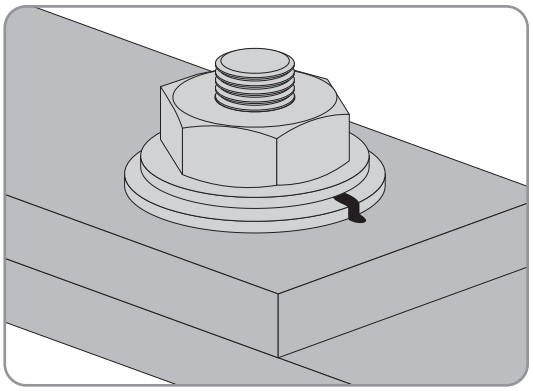
6.3.2.2 Checking the High-Current Contacts Made at the Factory

High-current contacts made at the factory

High-current contacts made at the factory are marked off. Providing that the marking is not damaged and runs across the bolted connection as shown in the figure, this means that the torque complies with the specifications.

Procedure:

- Check whether the high-current contacts made at the factory are correctly marked off.



If a high-current contact is not correctly marked off, release the high-current contact, tighten with the required torque and mark off again.

6.3.2.3 Checking the Connections of the Cables for Communication, Control Supply Voltage and Monitoring

Test Point	Tasks
Cables	Ensure that the cable type and cross-section, the number of cables and the labeling comply with the specifications in the schematic diagram.
Cable connection	Ensure that the cable connection complies with the specifications in the schematic diagram. If no external fast stop is to be installed, ensure that the terminals are wired with a jumper wire in accordance with the schematic diagram.
Cable insulation	Make sure that the insulation of the cables is correctly stripped. The insulation must not prevent the contact with the terminal.
Bootlace ferrules	Ensure that the bootlace ferrules are correctly crimped and that no stranded wires are visible.
Cable support rails	Ensure that the cables are adequately attached to the cable support rails.
Shield clamping saddles	Ensure that the contact between the cable shield and the shield bus is intact.

6.3.2.4 Checking the High-Current Contacts Made at the Installation Site

Test point	Tasks
Cables	Ensure that the cable type and cross-section, the number of cables and the labeling comply with the specifications in the schematic diagram.

Test point	Tasks
High-current contact	Check whether the high-current contacts established at the installation site are tightened to the correct torque. If the torque is not correct, release and clean the high-current contact and tighten with the required torque.
Terminal lugs	Ensure that the terminal lugs are crimped edge to edge.
Cable support rails	Ensure that the cables are adequately attached to the cable support rails.

6.3.3 Sunny Central

6.3.3.1 Checking the Settings of the Switching Units

Test Point	Tasks
AC circuit breaker	Ensure that the settings comply with the specifications in the schematic diagram.
GFDI	
Hygrostat	

6.3.3.2 Checking the Connectors

Test Point	Tasks
Connectors on the CAN bus	Ensure that all connectors are securely in place.
Connectors on the SC20cont	
Connectors on the inverter bridge	
Connectors on the communication unit	
Connectors on the hub	
Connectors on the router	

6.4 Connection and Measurement

6.4.1 Sequence for Connection and Measurement

Procedure	See
Use the tap changer on the MV transformer to adjust the voltage of the utility grid.	Section 6.4.2, page 78
Switch on the transformer panel and the ring circuit of the medium-voltage switchgear.	Section 7.8, page 105
Measure the voltages on the primary and secondary sides of the MV transformer and record the values in the commissioning report.	Section 6.4.3, page 78
Ensure that the supply voltage is within the permissible voltage range of the inverter of −10% to +15%.	Section 6.4.4, page 78
Check the output voltage of the inverter.	Section 6.4.5, page 78
Check the DC voltage.	Section 6.4.6, page 79

Procedure	See
Mount the protective covers.	Section 12.3.1.1, page 163
Mount the panels.	Section 12.3.1.2, page 164
Switch on the supply voltage and the AC disconnection unit.	Section 6.4.7, page 79

6.4.2 Adjusting the Transmission Ratio of the MV Transformer

Requirement:

☐ No voltage must be present at the MV transformer.

Procedure:

- Use the tap changer on the MV transformer to set the nominal voltage of the medium-voltage side. Set the voltages of the MV transformer during configuration.

6.4.3 Checking the Voltages of the MV Transformer

Requirement:

☐ The MV transformer must be connected (see Section 7.8, page 105).

Procedure:

- Measure the voltage at the low-voltage side and record it in the commissioning report. Set the voltages of the MV transformer during configuration.

6.4.4 Checking and Connecting the Supply Voltage

1. Ensure that the voltage on the primary side is within the permissible voltage range of the transformer for internal power supply.
2. Switch on the transformer circuit breaker of the transformer for internal power supply.
3. Check whether the supply voltage is within the permissible voltage range of the inverter.

   If the supply voltage deviates from the permissible voltage range of the inverter, adjust the transmission ratio of the transformer for internal power supply.

6.4.5 Checking the Output Voltage of the Inverter

1. Use a rotating field instrument to measure whether a right-hand rotating magnetic field is connected at the AC connection brackets.

   If a left-hand rotating magnetic field is detected, two line conductors must have been wrongly connected.

   - Swap the connections L1 and L3.
2. Check whether the AC voltage is approximately the same as the nominal voltage of the inverter. Measure the AC voltage between the terminals at the AC connection brackets and record in the commissioning report.

   If the AC voltage differs significantly from the nominal voltage of the inverter, the transformation ratio of the MV transformer must be adjusted by a duly authorized person.

6.4.6 Checking the DC Voltage

⚠ DANGER

Danger to life due to electric arcs if measuring device is not connected correctly

If the measurement points are incorrectly contacted, this can cause an electric arc. Electric arcs can result in death or serious injury.

- Select the appropriate measurement range on the measuring device.
- Wear suitable personal protective equipment for all work on the device.
- Select correct measurement points.

NOTICE

Damage to the inverter due to excessive DC voltages

The DC voltage of the PV array must not exceed the maximum voltage of the inverter.

- Make sure the maximum voltage is no more than 1,000 V.

Procedure:

1. Measure the DC voltage for each input and record it in the commissioning report. Use the DC+ and DC– connection brackets as measuring points.
2. Check that the DC voltages do not exceed the maximum DC voltage of the inverter.

   If the DC voltages differ from one another or exceed the maximum DC voltage, make sure that the cabling of the PV modules has been configured in accordance with the circuit diagram.
3. Make sure that the polarity of each input is correct.
4. Measure the DC voltage for each non-grounded pole to ground and record in the commissioning report. Use the connection brackets of the ungrounded terminal and the grounding busbar as check points.

   ☑ There is a measurable voltage drop.

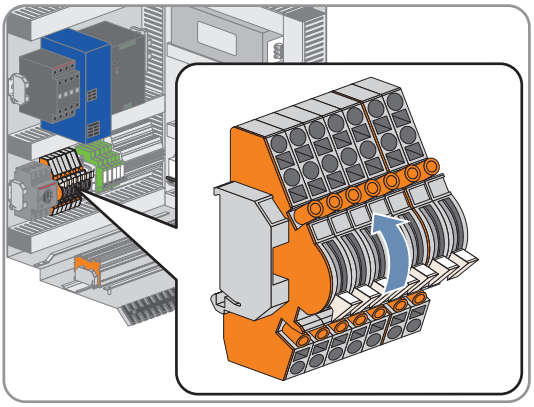
   ✖ There is no measurable voltage drop?

   A ground fault is present.

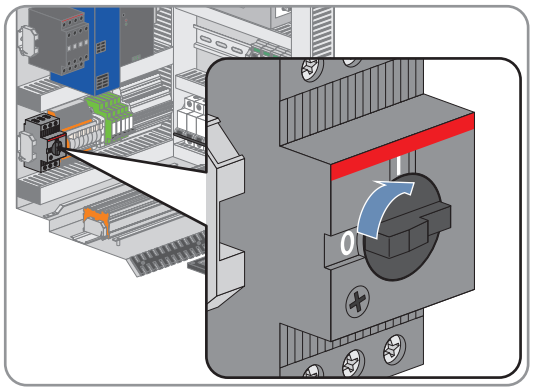
   - Eliminate the ground fault.

6.4.7 Switching On the Supply Voltage and the AC Disconnection Unit

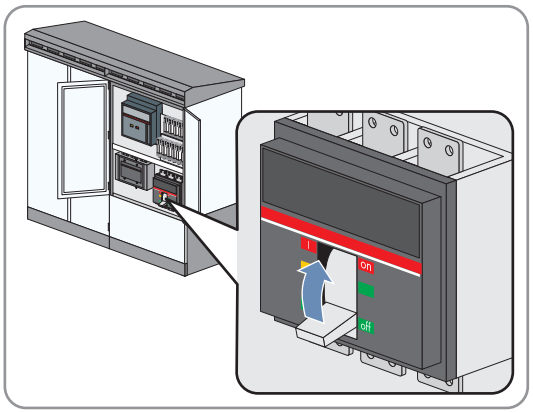
1. Close the measurement and disconnect terminals.



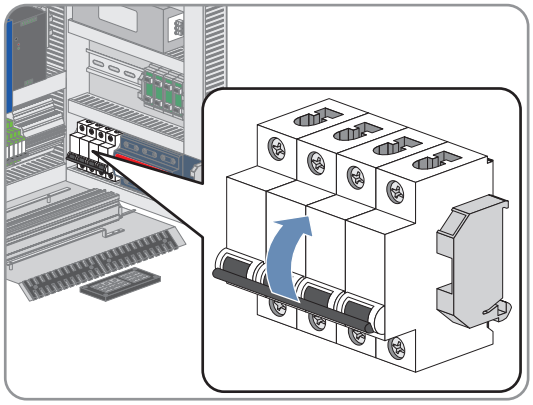
2. Switch on the motor-protective circuit-breaker of the grid monitoring.



3. Switch on the AC circuit breaker.



4. Switch the supply voltage circuit breaker on.



☑ The electronic components of the inverter switch on.

☑ The fans switch on and start drawing air in through the air intake vents.

✖ The fans do not switch on?

- Contact the Service (see Section 17, page 264).

6.5 Configuration

6.5.1 Checking the Settings of the Protective and Control Devices

If the medium-voltage switchgear in the MV Power Station is fitted with circuit breakers, a protective device is integrated in the medium-voltage switchgear. The protective device must be configured in accordance with the voltage level and the size of the MV transformer. Contact your contact person at SMA Solar Technology AG to obtain the document "MVSG-Protection Relay Settings" in which the default settings and explanations are stated. The final settings of the protective device must be made upon agreement with the electric utility company. The operator of the PV power plant is responsible for the correctness of the settings.

Procedure:

1. Set the protective device (see document "MVSG - Protection Relay Settings" and documentation of the medium-voltage switchgear). Observe the maximum current values on the medium-voltage side:

Medium-voltage switchgear	Grid voltage [kV]	Current on the high-voltage side of the MV transformer including 10% overload [A]				
		500 kVA	630 kVA	800 kVA	900 kVA	1,000 kVA
Manufacturer of the medium-voltage switchgear: Schneider Electric Type of the medium-voltage switchgear: FBX Protective device: Woodward WIC1-2PE	6.6	48.11	60.62	76.98	86.60	96.23
	10	31.75	40.01	50.81	57.16	63.51
	11	28.87	36.37	46.19	51.96	57.74
	12	26.46	33.34	42.34	47.63	52.92
	13.2	24.06	30.31	38.49	43.30	48.11
	13.8	23.01	28.99	36.82	41.42	46.02
	15	21.17	26.67	33.87	38.11	42.34
	20	15.88	20.01	25.40	28.58	31.75
	22	14.43	18.19	23.09	25.98	28.87
	23	13.81	17.40	22.09	24.85	27.61
Manufacturer of the medium-voltage switchgear: Schneider Electric Type of the medium-voltage switchgear: FLUSARC Protective device: VIP 45	24.94	12.73	16.04	20.37	22.92	25.46
	30	10.58	13.34	16.94	19.05	21.17
	31.5	10.08	12.70	16.13	18.15	20.16
	33	9.62	12.12	15.40	17.32	19.25
Manufacturer of the medium-voltage switchgear: Ormazabal Type of the medium-voltage switchgear: CGM.3 Protective device: eko-rRP	34.5	9.20	11.60	14.73	16.57	18.41
	35	9.07	11.43	14.52	16.33	18.15

Medium-voltage switchgear	Grid voltage [kV]	Current on the high-voltage side of the MV transformer including 10% overload [A]			
		1260 kVA	1600 kVA	1800 kVA	2000 kVA
Manufacturer of the medium-voltage switchgear: Schneider Electric Type of the medium-voltage switchgear: FBX Protective device: Woodward WIC1-2PE	6.6	121.24	153.96	173.21	192.45
	10	80.02	101.61	114.32	127.02
	11	72.75	92.38	103.92	115.47
	12	66.68	84.68	95.26	105.85
	13.2	60.62	76.98	86.60	96.23
	13.8	57.99	73.63	82.84	92.04
	15	53.35	67.74	76.21	84.68
	20	40.01	50.81	57.16	63.51
	22	36.37	46.19	51.96	57.74
	23	34.79	44.18	49.70	55.22
Manufacturer of the medium-voltage switchgear: Schneider Electric Type of the medium-voltage switchgear: FLUSARC Protective device: VIP 45	24.94	32.09	40.74	45.84	50.93
	30	26.67	33.87	38.11	42.34
	31.5	25.40	32.26	36.29	40.32
	33	24.25	30.79	34.64	38.49
Manufacturer of the medium-voltage switchgear: Ormazabal Type of the medium-voltage switchgear: CGM.3 Protective device: ekorRP	34.5	23.19	29.45	33.13	36.82
	35	22.86	29.03	32.66	36.29

2. For order option "Grid protection", check the settings of the voltage and frequency monitoring relay and correct them, if necessary (see documentation of the voltage and frequency monitoring relay).
3. For order option "Cascade control", set the time delay in the control device according to the specifications of the grid operator (see documentation of the control device).

6.5.2 Configuring the Network Settings on the Computer

Before your computer can communicate with the inverter, you must set the computer to the network settings of the inverter. The network settings include the IP address, subnet mask, gateway and DNS server address.

The communication interface of the inverter has three LAN interfaces to the connected nodes. The IP address to be configured in your computer depends on whether the computer is connected to the service interface of the inverter, the control network or the monitoring network.

Network	Default IP address
LAN1: Service interface of the inverter	192.168.100.2*
LAN2: Control network	172.24.1.51
LAN3: Monitoring network	172.16.1.51

* This IP address cannot be changed.

Administrator rights in the operating system

To commission the communication unit, you need to have the appropriate administrator rights to change the network settings of the computer.

- Contact your network administrator if you are uncertain about administrator rights.

Procedure:

1. Note down the IP address of the computer.
2. Adapt the IP address of the computer to the address range of the communication unit.

6.5.3 Information on Integrating the Inverter into a Local Network

Protecting the local network from cyber attacks

- If the local network is to be accessible via the Internet, you can set up port forwarding via your router or configure a VPN. Using a VPN is recommended.
- Protect the local network from cyber attacks by means of suitable safety measures such as setting up a firewall and allocating secure passwords.

Using a static IP address is recommended. You can select the IP address yourself. Use the address range which is available to your router. If necessary, refer to the router manual.

If you are using a Power Plant Controller for the automatic control of your PV power plant, a dynamic IP address with DHCP is not possible.

For further information on this subject, see the Technical Information "System Communication in Large-Scale PV Power Plants" at www.SMA-Solar.com.

6.5.4 Configuring the Inverter for a Static Network

You can configure the IP address of the inverter for the control network and the monitoring network via the user interface. Alternatively, you can also change the network settings of the inverter via the XML file **custom.xml** (see Section 6.5.14, page 93).

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > Network**.
3. In the field **IP address**, enter the static IP address that you want to use to access the inverter in the local network.
4. Enter the subnet mask of your network in the field **Subnet mask**.
5. Enter the gateway IP address of your network in the field **Gateway address**. Usually, the IP address of the router has to be entered here.
6. Enter the IP address of the DNS server (Domain Name System) in the field **DNS server address**. Usually, the IP address of the router has to be entered here.

7. Select the button [**Save**].
8. Select the button [**Confirm**].

6.5.5 Adjusting Network Ports

If you wish the inverter to be accessible via the Internet so that you can access it, for example, directly from Sunny Portal, you must configure port forwarding in your router. This may require adjustment of the network ports.

For the various services, the communication unit of the inverter uses four network ports. If these ports are reserved for other applications in your network, you can adjust the ports.

i Adjusting the network ports

Check your access to the user interface before you change the setting **Public virtual HTTP port** on the user interface. In most cases, the settings do not have to be changed manually, as the router automatically forwards the queries to the correct ports via the network. Before adjusting the ports, contact your network administrator.

i Unauthorized access to the inverter

If you activate the Modbus protocol, unauthorized access to the inverter will be possible. In this case, even users without a password will be able to view the instantaneous values of supported devices or perform actions such as changing the system time. Using a VPN is recommended.

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > Network**.
3. In the field **Virtual public HTTP port**, enter the port enabled in the router for HTTP access. Via this port, you can access the user interface from the Internet.
4. In the field **Webserver port**, enter the port via which the user interface can be accessed.
5. In the field **Webservice port**, enter the port via which the data of the inverter is to be transmitted to Sunny Portal and firmware updates are to be uploaded.
6. If you would like to use the Modbus protocol, activate the box **Use Modbus**.
7. In the field **Modbus port**, enter the port to be used by the inverter when communicating via the Modbus protocol. The default setting is port **502**.
8. If you would like to use a proxy server, activate the box **Use proxy server**.
9. Enter the IP address and the port of the proxy server in the field **Proxyserver address**.
10. If you would like to use the authentication of the proxy server, activate the box **Use authentication**.
11. Enter the data of your proxy server in the fields **User name** and **Password**.
12. Select the button [**Save**].

6.5.6 Detecting New Devices

During commissioning of a PV power plant, all devices must be detected. If multiple interfaces (e.g. COM2 and COM3) are used in the inverter, detection of new devices must be carried out separately for all interfaces.

Devices will need to be redetected if you have:

- replaced devices in your PV power plant
- removed devices from your PV power plant
- added devices to your PV power plant

Detection of the PV power plant may take several minutes

Depending on the number of devices in your PV power plant, the duration of the detection process may vary.

- If there is no indication of progress on the communication unit after three minutes, cancel the search.
- Make sure the data cable of each device is properly connected and repeat the search.

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Data** > **Detection**.
3. In the field **Total number of devices to be detected**, enter the number of devices connected to the communication unit. Hint: If you do not know the number, enter **1**.
4. Select the button **[Start detection].**
   ☑ The communication unit starts detecting all inverters and displays its progress. Once all devices have been detected, the message **### Device detection finished ###** is displayed.
5. Select the button [**OK**].

6.5.7 Setting the Power Limitation

6.5.7.1 Setting the Active Power Ramp-Up

Parameter block

Some parameters must only be changed in the operating state "Stop". The entry will not be accepted in any other operating state.

The inverter works up to its maximum feed-in power via a ramp. This means that the inverter gradually increases the ratio of feed-in power per second by the value set in the parameter **WGra**.

Procedure:

1. Make sure the inverter is in the operating state "Stop".
2. Call up the parameter overview (see Section 12.8.3, page 178).
3. Set the parameter **WGra** to the required value.
4. Save the parameter changes (see Section 12.8.4, page 178).

6.5.7.2 Setting the Frequency-Dependent Active Power Limitation

Parameter block

Some parameters must only be changed in the operating state "Stop". The entry will not be accepted in any other operating state.

Procedure:

1. Make sure the inverter is in the operating state "Stop".
2. Call up the parameter overview (see Section 12.8.3, page 178).
3. If necessary, set the parameter **WCtlHzMod** to **CurveHys**.
4. Change the parameters **P-HzStr**, **P-HzStop** and **P-WGra** and save (see Section 12.8.4, page 178).
5. Save the parameter changes (see Section 12.8.4, page 178).

6.5.7.3 Setting the Frequency-Independent Active Power Limitation

NOTICE

Operation failure of the PV power plant due to incorrectly set parameters

If the parameter settings for grid management services are incorrect, the PV power plant may not be able to meet the requirements of the grid operator. This can involve yield losses and the inverter may have to be disconnected by the grid operator.

- When setting the modes of grid management services, ensure that the control procedures agreed with the grid operator are parameterized.
- If the inverter is operated with a Power Plant Controller, ensure that the mode **WCtlCom** for active power limitation and the mode **VArCtlCom** for reactive power control are selected in the inverter.

Parameter block

Some parameters must only be changed in the operating state "Stop". The entry will not be accepted in any other operating state.

Procedure:

1. Make sure the inverter is in the operating state "Stop".
2. Call up the parameter overview (see Section 12.8.3, page 178).
3. Set the parameter **P-WMod** to the desired value.
4. Change the parameters belonging to the selected mode (see Section 13.3.2, page 191).
5. Use the parameter **PwrMonErrMod** to select the desired behavior in the absence of setpoint specifications as follows (see Section 13.3.5, page 204).
6. If **SubVal** has been selected, enter the substitute values for normal feed-in operation and for operation outside of normal feed-in operation.
7. In the parameter **PwrMonErrTm** configure the time lapse until recognition of the absence of setpoint specifications.
8. Save the parameter changes (see Section 12.8.4, page 178).

6.5.7.4 Setting Reactive Power Control

NOTICE

Operation failure of the PV power plant due to incorrectly set parameters

If the parameter settings for grid management services are incorrect, the PV power plant may not be able to meet the requirements of the grid operator. This can involve yield losses and the inverter may have to be disconnected by the grid operator.

- When setting the modes of grid management services, ensure that the control procedures agreed with the grid operator are parameterized.
- If the inverter is operated with a Power Plant Controller, ensure that the mode **WCtlCom** for active power limitation and the mode **VArCtlCom** for reactive power control are selected in the inverter.

Avoiding electromagnetic interference emissions in large-scale PV systems

To avoid electromagnetic interference emissions in large-scale PV systems at the changeover from night mode to feed-in operation, it is recommended using Modbus communication for setpoint in feed-in operation and night mode.

For smaller-sized PV systems without farm control, the use of fixed setpoints for reactive power control is recommended.

Validity of parameters in feed-in operation and in "Q at Night" operation

The parameters used for these substitute values are valid in feed-in operation and in "Q at Night" operation.

- Ensure that the settings of the parameters for the substitute values meet the requirements for feed-in operation and "Q at Night" operation.

Procedure:

1. Make sure the inverter is in the operating state "Stop".
2. Call up the parameter overview (see Section 12.8.3, page 178).
3. Set the parameter **Q-VArMod** to the desired value.
4. Change the parameters belonging to the selected mode (see Section 13.3.3, page 192).
5. Use the parameter **PwrMonErrMod** to select the desired behavior in the absence of setpoint specifications as follows (see Section 13.3.5, page 204).
6. If **SubVal** has been selected, enter the substitute values for normal feed-in operation and for operation outside of normal feed-in operation.
7. In the parameter **PwrMonErrTm** configure the time lapse until recognition of the absence of setpoint specifications.
8. Save the parameter changes (see Section 12.8.4, page 178).

6.5.7.5 Setting Q at Night

NOTICE

Operation failure of the PV power plant due to incorrectly set parameters

If the parameter settings for grid management services are incorrect, the PV power plant may not be able to meet the requirements of the grid operator. This can involve yield losses and the inverter may have to be disconnected by the grid operator.

- When setting the modes of grid management services, ensure that the control procedures agreed with the grid operator are parameterized.
- If the inverter is operated with a Power Plant Controller, ensure that the mode **WCtlCom** for active power limitation and the mode **VArCtlCom** for reactive power control are selected in the inverter.

Avoiding electromagnetic interference emissions in large-scale PV systems

To avoid electromagnetic interference emissions in large-scale PV systems at the changeover from night mode to feed-in operation, it is recommended using Modbus communication for setpoint in feed-in operation and night mode.

For smaller-sized PV systems without farm control, the use of fixed setpoints for reactive power control is recommended.

Validity of parameters in feed-in operation and in "Q at Night" operation

The parameters used for these substitute values are valid in feed-in operation and in "Q at Night" operation.

- Ensure that the settings of the parameters for the substitute values meet the requirements for feed-in operation and "Q at Night" operation.

Procedure:

1. Make sure the inverter is in the operating state "Stop".
2. Call up the parameter overview (see Section 12.8.3, page 178).
3. Set the parameter **QoDQ-VarMod** to the desired value.
4. Change the parameters belonging to the selected mode (see Section 13.3.4, page 199).

5. Use the parameter **PwrMonErrMod** to select the desired behavior in the absence of setpoint specifications as follows (see Section 13.3.5, page 204).
6. If **SubVal** has been selected, enter the substitute values for normal feed-in operation and for operation outside of normal feed-in operation.
7. In the parameter **PwrMonErrTm** configure the time lapse until recognition of the absence of setpoint specifications.
8. Save the parameter changes (see Section 12.8.4, page 178).

6.5.8 Setting Grid Monitoring and Grid Limits

6.5.8.1 Setting Grid Voltage Monitoring

Consultation prior to parameter change

The parameters of this mode can only be selected or changed after consultation (see Section 17 "Contact", page 264).

Procedure:

1. Call up the parameter overview (see Section 12.8.3, page 178).
2. Set the parameters for monitoring the grid voltage (see Section 13.1.3.1, page 180).
3. Save the parameter changes (see Section 12.8.4, page 178).

6.5.8.2 Setting Power Frequency Monitoring

Consultation prior to parameter change

The parameters of this mode can only be selected or changed after consultation (see Section 17 "Contact", page 264).

Procedure:

1. Call up the parameter overview (see Section 12.8.3, page 178).
2. Set the parameters for monitoring the power frequency (see Section 13.1.3.2, page 181).
3. Save the parameter changes (see Section 12.8.4, page 178).

6.5.8.3 Activating the Manual Resume Mode

If the inverter is switched off due to a grid limit infringement, you can prevent an automatic restart of the inverter. Only once the error has been acknowledged will the inverter switch back on. You can activate the Manual Resume Mode for individual errors of grid limit infringement. You can read off the reason for the current restart block in the instantaneous value **ManResStt**.

Procedure:

1. Call up the parameter overview (see Section 12.8.3, page 178).
2. To activate the Manual Resume Mode for individual disturbances, set the desired parameters to **On**:

Manual Resume Mode after	Parameter
Disconnection due to overvoltage	**ManResOvrVol**
Disconnection due to undervoltage	**ManResUndrVol**
Disconnection due to overfrequency	**ManResOvrFrq**
Disconnection due to underfrequency	**ManResUndrFrq**

Manual Resume Mode after	Parameter
Disconnection due to passive islanding detection	**ManResPID**
Disconnection due to disturbance in a line conductor	**ManResPLD**

3. Save the parameter changes (see Section 12.8.4, page 178).

6.5.9 Setting the Grid Support

6.5.9.1 Setting Full and Limited Dynamic Grid Support (FRT)

1. Call up the parameter overview (see Section 12.8.3, page 178).
2. Set dynamic grid support with the parameter **FRTEna**.
3. Set operating mode for dynamic grid support with the parameter **FRTMod**.
4. Set deactivation delay for LVRT with the parameter **FRTSwOffTm**.
5. Set the scaling of the k factor for LVRT with the parameter **FRTArGraNom**.
6. Set the upper limit of the voltage deadband with the parameter **FRTDbVolNomMax**.
7. Set the lower limit of the voltage deadband with the parameter **FRTDbVolNomMin**.
8. In operating mode FRT_SDLWindV, set the gradient for the FRT characteristic curve in case of overvoltage with the parameter **FRT2ArGraNomHi**.
9. For the operating mode FRT_SDLWindV, set the gradient for the FRT characteristic curve in case of undervoltage with the parameter **FRT2ArGraNomLo**.
10. Save the parameter changes (see Section 12.8.4, page 178).

6.5.9.2 Setting Enable Islanding Detection

1. Call up the parameter overview (see Section 12.8.3, page 178).
2. Set the islanding detection with the parameter **EnaAid**.
3. Save the parameter changes (see Section 12.8.4, page 178).

6.5.9.3 Setting the Medium Voltage

The line-to-line voltage of the overvoltage side of the MV transformer (parameter **TrfVolExlHi**) has to be adapted to the nominal conductor voltage of the utility grid (parameter **VRtg**). It is important that the transmission ratio of the external MV transformer is adjusted at the same time. The undervoltage side is already preset for the specific device.

Procedure:

1. Call up the parameter overview (see Section 12.8.3, page 178).
2. Set the parameter **TrfVolExlHi**.
3. Set the parameter **VRtg**.
4. Save the parameter changes (see Section 12.8.4, page 178).

6.5.10 Setting the Remote Shutdown

1. Call up the parameter overview (see Section 12.8.3, page 178).
2. To activate remote shutdown, set the parameter **ExlStrStpEna** to **On** (see Section 13.2.1.2, page 184).
3. To deactivate remote shutdown, set the parameter **ExlStrStpEna** to **Off** (see Section 13.2.1.2, page 184).
4. Save the parameter changes (see Section 12.8.4, page 178).

6.5.11 Setting the String Current Monitoring

6.5.11.1 Detecting the Sunny Central String-Monitor Controller and the Inverter

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Data > Detection**.
3. In the field **Total number of devices to be detected**, enter the value **2**.
4. Select the button **[Start detection].**

☑ The communication unit starts detecting all inverters and displays its progress. Once all devices have been detected, the message **### Device detection finished ###** is displayed.

☑ The devices have been detected.

6.5.11.2 Setting the Date and Time of the Sunny Central String-Monitor Controller

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Data > Devices**.
3. Select  .

   ☑ A list of the existing device types appears.
4. Select **Sunny Central String-Monitor Controller**.
5. Select the tab **Instantaneous values**.
6. Make sure that the date **SysDt** and time **SysTm** of the Sunny Central String-Monitor Controller are correct.

   If the settings are incorrect, change the parameters **Dt** and **Tm** .

6.5.11.3 Detecting the Sunny String-Monitors via the Sunny Central String-Monitor Controller

It may take several minutes to detect the Sunny String-Monitors, depending on the number of devices and how far apart they are.

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select the tab **Parameters**.
3. Set the parameter **DevFunc** to **AutoDetect_SSMU**.
4. Select the button [**Save**].
5. Select the tab **Instantaneous values**.
6. Select **SSMUNoOf** and check the number of detected Sunny String-Monitors.

   Once all Sunny String-Monitors have been detected, detect them via the communication unit(see Section 6.5.11.5, page 91).

   If only some of the Sunny String-Monitors have been detected, use Sunny Central String-Monitor Controller to redetect them (see Section 6.5.11.4, page 90).

6.5.11.4 Redetecting the Sunny String-Monitors via the Sunny Central String-Monitor Controller

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select the tab **Parameters**.
3. Set the parameter **DevFunc** to **Retry**.
4. Select the button [**Save**].

5. Select the tab **Instantaneous values**.
6. Select **SSMUNoOf** and check the number of detected Sunny String-Monitors.

   Once all Sunny String-Monitors have been detected, detect them via the communication unit(see Section 6.5.11.5, page 91).

   If only some of the Sunny String-Monitors have been detected, contact the Service .

6.5.11.5 Detecting the Sunny String-Monitors via the Communication Unit

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Data > Detection**.
3. In the field **Total number of devices to be detected**, enter the number of Sunny String-Monitors +2.
4. Select the button **[Start detection].**

☑ The communication unit starts detecting all inverters and displays its progress. Once all devices have been detected, the message **### Device detection finished ###** is displayed.

☑ The Sunny String-Monitors have been detected.

6.5.11.6 Adjusting the Identification of the Sunny String-Monitors

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select the first Sunny String-Monitor from the device list.
3. Select the tab **Parameters**.
4. Select the parameter **SSMId** and allocate a unique identification number to the Sunny String-Monitor. Note the identification number.
5. Adjust the identification of the remaining Sunny String-Monitors using the same process.

6.5.12 Changing System Settings via Touch Display

6.5.12.1 Selecting the Language

1. Select .
2. Select .
3. Use the country symbol to select the language.
4. Confirm your entry by selecting .

6.5.12.2 Setting the Date, Time and Time Zone

Inverter adopts changes

The inverter will adopt date, time or time zone changes made via the display.

Procedure:

1. Select .
2. Select .
3. To change the date, select the day, month and year in the field . Use the and buttons to change the day, month and year.
4. To change the time, select the hours, minutes and seconds in the field . Use and to change the hours, minutes and seconds.
5. To change the time zone, select a time zone in the field . Use the and buttons to change the time zone.
6. Confirm your entry by selecting .

6.5.12.3 Selecting the Display Format

1. Select .
2. Select .
3. Select the date format.
4. Select the hour format.
5. Select the number format.
6. Confirm your entry by selecting .

6.5.12.4 Setting the Brightness

1. Select .
2. Select .
3. Set the display brightness. Select for a darker screen or for a lighter screen.
4. Confirm your entry by selecting .

6.5.13 Changing the System Settings via the User Interface

6.5.13.1 Selecting the Language

You can also set the language of the user interface via the XML file **custom.xml** (see Section 6.5.14, page 93).

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > System**.
3. Select the desired language in the field **Language**.
4. Select the button [**Save**].
5. To log off from the user interface, select the button [**Logout**].

6.5.13.2 Setting the Date, Time and Time Zone

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > System**.
3. Select [**Change**] in the field **Time zone (UTC offset)**.
4. Select the correct time zone in the **Time zone (UTC offset)** drop-down list.
5. Select an option in the **Automatic change from summer time to winter time** field:

Option	Explanation
yes	Automatic change from daylight saving time to standard time is active.
no	Automatic change from daylight saving time to standard time is not active. Date and time have to be set manually.

6. Enter the current date in the **New date** field.
7. Enter the current time in the **New time** field.
8. Select [**Save**].
9. To log off from the user interface, select the button [**Logout**].

6.5.13.3 Entering the Operator Name

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > System**.
3. Enter the operator name in the **Operator name** field.
4. Select the button [**Save**].
5. To log off from the user interface, select [**Logout**].

6.5.13.4 Changing the Password for the User Groups

The user interface distinguishes between the user groups "user" and "installer" . To change the password for the "installer" user group, you must be logged in as an installer. To change the password for the "user" user group, you can be logged in as a user or an installer.

Identical passwords for the user groups

If your "User" password is the same as your "Installer" password, you will automatically be logged in as an installer.

During entry of the password, the user interface displays information on the security level of the password entered. Passwords are categorized as very unsafe, unsafe, adequate, safe and very safe. Only choose passwords with at least the security level safe. You can also change the password of the "installer" user group via the XML file **custom.xml** (see Section 6.5.14, page 93).

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > Security**.
3. Enter a secure password in the **User password** or **Installer password** field and confirm it in the second field.
4. Select the button [**Save**].
5. To log off from the user interface, select the button [**Logout**].

6.5.14 Configuring System Settings via XML File

6.5.14.1 Uploading the File custom.xml

When you upload the file **custom.xml** to the user interface, the communication unit checks the file to ensure that the values entered are valid and accurate, and adopts the settings at the next reset of the communication unit.

Correct network settings

While uploading, the communication unit checks the XML file **custom.xml** for validity and accuracy of the entered values. The accuracy of the network settings is not checked.

- Ensure that the file **custom.xml** includes the correct network settings.

Procedure:

1. Create the file **custom.xml** with the required settings (see Section 16.4, page 260).
2. Log into the user interface as an installer (see Section 12.8.1, page 177).
3. Select **Sunny Central > Settings > System**.
4. Select [**Browse**] in the field **Upload settings (custom.xml)**.
5. Double-click on the file **custom.xml** in the open dialog box.

6. Select the button [**Upload**].
   ☑ The message **Do you really want to apply the customer-specific settings** is displayed.
   ✖ The message **The settings have not been activated because the file has an invalid format or invalid entries.** is displayed?
   - Click on the ⓘ symbol.
   - Read off the error in the open dialog box and correct the file **custom.xml**.
   - Ensure that the file **custom.xml** is valid and correct.
7. Select the button [**Confirm**].
   ☑ The following message is displayed: **The settings were successfully saved. The settings will become effective by carrying out a reset to default settings**.
8. To enable the settings in the file **custom.xml.**, the communication unit must be reset to the default settings (see Section 6.5.15, page 94).
9. To log off from the user interface, select the button [**Logout**].

6.5.14.2 Downloading the File custom.xml

The file **custom.xml** that you have uploaded can also be downloaded.

Procedure:

1. Log into the user interface as an installer (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > System**.
3. Click on the link **(custom.xml)** in the field **Upload settings (custom.xml)**.
4. Choose a storage location for the file and save it.
5. To log off from the user interface, select the button [**Logout**].

6.5.14.3 Deleting the File custom.xml

You can delete the file **custom.xml** via the user interface. If you have enabled your personal settings via the file **custom.xml** before deleting it, these settings will remain effective.

No confirmation after deleting the file custom.xml

If you perform the following steps, the file **custom.xml** will be deleted immediately without displaying a dialog box confirming the deletion.

- Save the file **custom.xml** before deleting it.

Procedure:

1. Log into the user interface as an installer (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > System**.
3. In the field **Upload settings (custom.xml)**, select the button [**Delete**].
   ☑ The file **custom.xml** is immediately deleted.
4. To log off from the user interface, select the button [**Logout**].

6.5.15 Resetting the Communication Unit

Resetting the communication unit will restore all of its original default settings. If you have uploaded an XML file **custom.xml**, the settings of this file will be adopted (see Section 6.5.14.1 "Uploading the File custom.xml", page 93).

Perform data backup

- Before you reset the communication unit, note down all settings such as network or portal settings.
- To avoid data loss, be sure to back up your operating data.

PV system identifier in Sunny Portal

If you reset all settings, all settings for logging into Sunny Portal will also be deleted. If you restart the communication unit after the reset without changing any settings, the communication unit will create a new PV system with a new PV system identifier in Sunny Portal.

- If the data is to be sent to the existing PV system in Sunny Portal, adjust the identifier of the old PV system (see Section 8.2.2.2, page 109).
- Enter the e-mail address of a user who has Sunny Portal administrator rights for the PV system.

Procedure:

1. Log into the user interface as an installer (see Section 12.8.1, page 177).
2. Select **Sunny Central > Info**.
3. Select the button [**Default setting**].
   ☑ A security prompt opens.
4. Select the button [**Confirm**].
5. To log off from the user interface, select [**Logout**].

6.6 Function Test

6.6.1 Checking the Fans

DANGER

Danger to life due to electric shock or electric arc if live components are touched

- Switch off the inverter and wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Disconnect the inverter (see Section 7, page 98).

Procedure:

1. Switch the inverter to **Stop**.
2. Connect the supply voltage (see Section 7.9.1, page 106).

☑ The fans start to run for a few moments.

✖ The fans do not start up?

- Contact SMA Service Line.

6.6.2 Checking the Heating Elements and Hygrostat

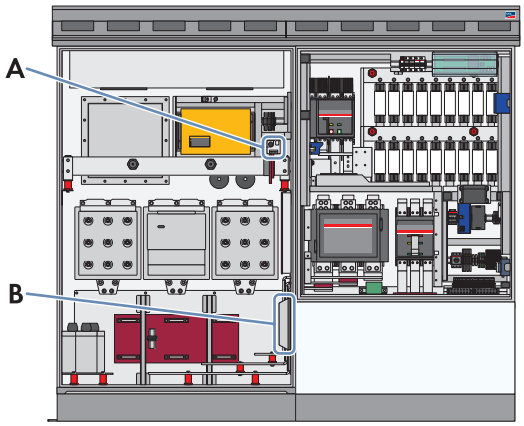


Figure 39: Position of the heating element and the hygrostat

Position	Designation
A	Hygrostat
B	Heating element

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7.6, page 104).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

⚠ CAUTION

Risk of burns due to hot components

Some components of the product can get very hot during operation. Touching these components can cause burns.

- Observe the warnings on all components.
- During operation, do not touch any components marked with such warnings.
- After switching off the product, wait until any hot components have cooled down sufficiently.
- Wear suitable personal protective equipment for all work on the product.

Procedure:

1. Switch the inverter to **Stop** (see Section 7.4.1, page 102).
2. Connect the supply voltage (see Section 7.9.1, page 106).
3. Set the hygrostat to the minimum value. To do this, pull the selector switch out slightly.
   Tip: the hygrostat is adjusted correctly if the relay of the hygrostat emits an audible click.

4. Check whether the heating elements are radiating heat after a delay time of five minutes.

   If the heating elements are not radiating heat, contact us (see Section 17 "Contact", page 264).

5. Reset the hygrostat to the initial value. To do this, press the selector switch back towards the hygrostat. The initial value of the hygrostat is indicated in the circuit diagram.

6.7 Switching the Inverter On

Requirements:

☐ All electrical connections executed on site must be correct and firmly attached.

☐ The entire PV power plant, including the PV array, must have been tested by the PV system builder in accordance with the applicable standards.

☐ A test protocol of the tests carried out must have been compiled in accordance with the applicable standards.

☐ The ground resistance of the PV system must have been determined.

☐ All values measured must be within the permissible range.

Procedure:

1. Lock the inverter.
2. Turn the key switch to **Start**.

☑ The DC switch switches on with an audible click.

☑ Under conditions of sufficient irradiation, the inverter starts feeding into the utility grid.

✖ Disturbance message on the touch display?

- Eliminate the disturbance (see Section 9, page 118).

7 Disconnecting and Reconnecting

7.1 Safety When Disconnecting and Reconnecting Voltage Sources

⚠ DANGER

Danger to life due to applied voltages

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Always disconnect the product from the power transmission path and from the control path if no voltage is required for working on the product (see Section 7, page 98).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 7.4, page 102).
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk categories of the various areas of the product are different. The areas are identified with warning labels.
- Wear suitable personal protective equipment for all work when the control path is connected.
- Always perform all work in accordance with the locally applicable standards, directives and laws.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- The product must not be operated with open covers or doors.

⚠ DANGER

Danger to life due to electric arcs if measuring device is not connected correctly

If the measurement points are incorrectly contacted, this can cause an electric arc. Electric arcs can result in death or serious injury.

- Select the appropriate measurement range on the measuring device.
- Wear suitable personal protective equipment for all work on the device.
- Select correct measurement points.

⚠ WARNING

Danger to life due to arc fault caused by fault in the medium-voltage switchgear

If there is a fault in the medium-voltage switchgear, arc faults may occur during operation of the product which can result in death or serious injuries. If arc faults occur in the medium-voltage switchgear, the pressure evacuates under the compartment of the medium-voltage switchgear.

- Only perform work on the medium-voltage switchgear when it is in a voltage-free state.
- Only perform switching operations on the medium-voltage switchgear from the service platform.
- Do not touch or access the roof of the medium-voltage switchgear when medium voltage is connected.
- When switching operations are performed, all persons that are not on the service platform have to keep a safe distance from the product.
- All work and switching operations on the medium-voltage switchgear must only be performed by qualified persons wearing adequate personal protective equipment.

⚠ WARNING

Danger to life due to applied voltages as a result of automatic reconnection

If the automatic cascade control is activated, it is possible that the voltage is automatically reconnected when working on the medium-voltage switchgear. Touching live components can result in death or serious injury due to electric shock.

- For the order option "Cascade control", deactivate the automatic reconnection function at the control device and the medium-voltage switchgear.
- Deactivate the automatic reconnection function in the superordinate MV Power Station with cascade control.
- Ensure that the control device cannot be accidentally switched on again.
- Wear suitable personal protective equipment for all work on the product.

⚠ WARNING

Hearing impairment due to high-frequency noises of the inverter

The inverter generates high-frequency noises when in operation. This can result in hearing impairment.

- Wear personal protective equipment for all work on the product.
- Wear hearing protection.

⚠ CAUTION

Risk of burns due to hot components

Some components of the product can get very hot during operation. Touching these components can cause burns.

- Observe the warnings on all components.
- During operation, do not touch any components marked with such warnings.
- After switching off the product, wait until any hot components have cooled down sufficiently.
- Wear suitable personal protective equipment for all work on the product.

i Connect and disconnect the AC voltage of the MV transformer

Only a duly authorized person is allowed to connect and disconnect the AC voltage of the MV transformer.

7.2 Connection Point Overview

7.2.1 Power Connection Points

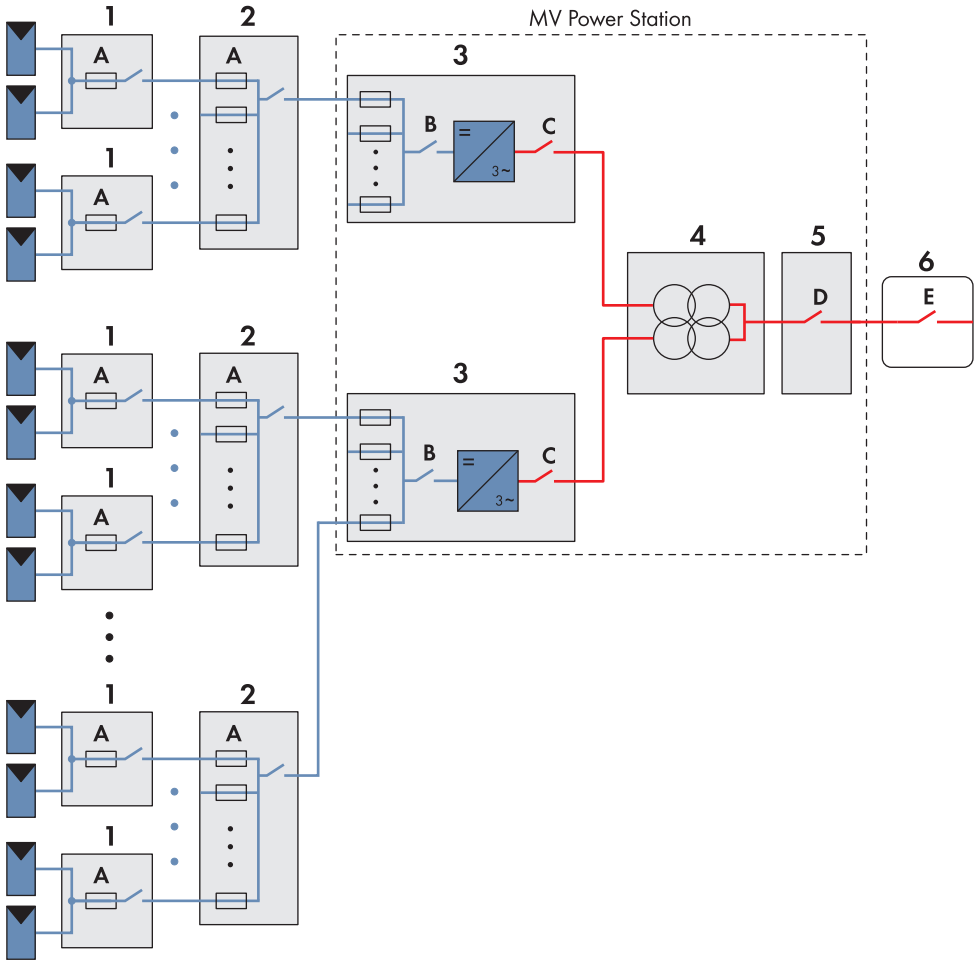


Figure 40: Overview of the power connection points

Position	Designation
1	DC subdistribution, e.g. Sunny String-Monitor
2	DC main distribution, e.g. Sunny Main Box Cabinet
3	Inverter
4	MV transformer
5	Medium-voltage switchgear
6	Higher-level medium-voltage switchgear (string, ring or transfer station)
A	Disconnection device of the DC subdistribution or the DC main distribution
B	DC switchgear of the inverter
C	AC disconnection unit of the inverter
D	Medium-voltage switch
E	Disconnection device of the transfer station

7.2.2 Connection Points for Supply Voltage

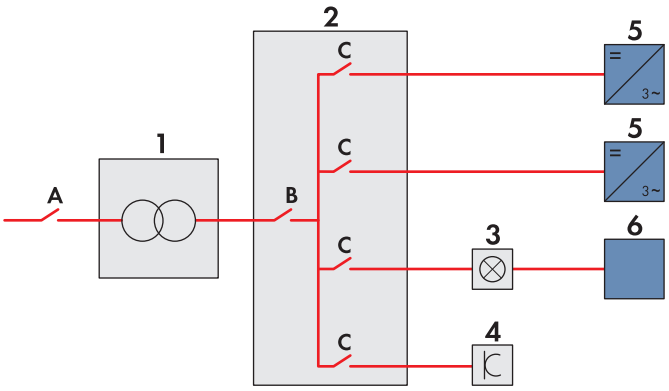


Figure 41: Connection points for supply voltage

Position	Designation
1	Transformer for internal power supply
2	Station subdistribution
3	Lighting
4	Outlet
5	Inverter
6	Communit
A	Transformer circuit breaker
B	Circuit breaker of the entire station subdistribution
C	Circuit breakers of the station subdistribution devices

7.3 Disconnecting the Supply Voltages of the Station Subdistribution

The circuit breakers for the different devices of the MV Power Station are located in the station subdistribution.

Procedure:

1. For disconnecting the inverters from the supply voltage, switch off the circuit breakers **Voltage Supply SC1** and **Voltage Supply SC2**.
2. For disconnecting the Communit and its lighting from the supply voltage, switch off the circuit breaker **Voltage Supply Lighting/Communit**.
3. For disconnecting the optional fans from the supply voltage, switch off the circuit breaker **Fan**.
4. For disconnecting the outlet from the supply voltage, switch off the circuit breaker **Socket**.
5. For disconnecting the entire MV Power Station from the supply voltage, switch off the main switch **Voltage Supply Power Outlet**.
6. For disconnecting the transformer for internal power supply, switch off the transformer protective device.

7.4 Disconnecting the Inverter

7.4.1 Switching off the Inverter

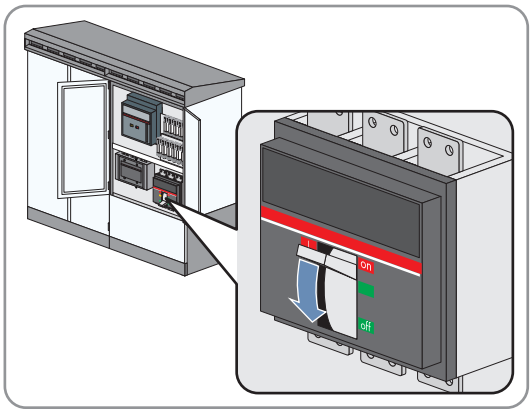
1. Turn the key switch to **Stop**.
2. Remove the key. This will protect the inverter from inadvertent reconnection.
3. Wait 15 minutes before opening the doors. This allows the inverter capacitors to discharge.

7.4.2 Disconnecting the DC Side

1. Switch off the inverter (see Section 7.4.1, page 102).
2. Disconnect all poles of the DC voltage in the DC main distribution or DC subdistribution (see documentation of the main or subdistribution).
3. Ensure that the DC switchgear in the inverter is open.
4. Ensure that no voltage is present on the load side of the DC switchgear.
5. Cover or isolate any adjacent live components.
6. Remove the protective covers over the fuses.
7. Remove all fuses and disconnection blades from all fuse holders of the inverters. Use an LV/HRC fuse extractor.

7.4.3 Disconnecting the AC Side

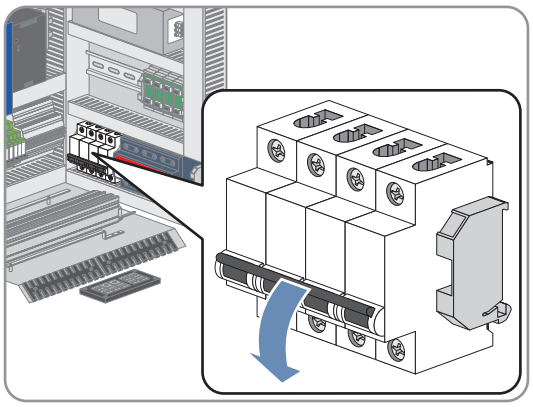
1. Switch off the inverter (see Section 7.4.1, page 102).
2. Disconnect the DC side (see Section 7.4.2, page 102).
3. Disconnect the AC voltage of the MV transformer (see Section 7.5, page 103).
4. Switch off the AC disconnection unit in the inverter.



5. Ensure that no voltage is present.
6. Cover or isolate any adjacent live components.

7.4.4 Disconnecting the Supply Voltage and External Voltages

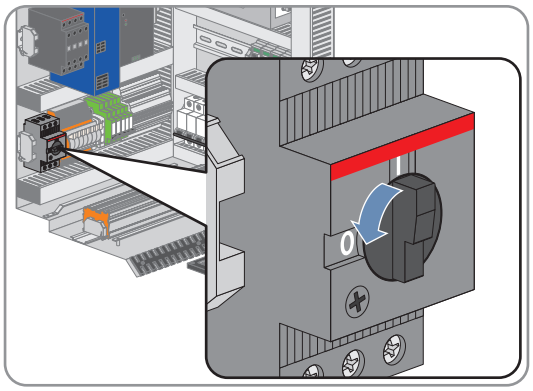
1. If the supply voltage is only to be disconnected upstream from the circuit breaker, switch the circuit breaker of the supply voltage off.



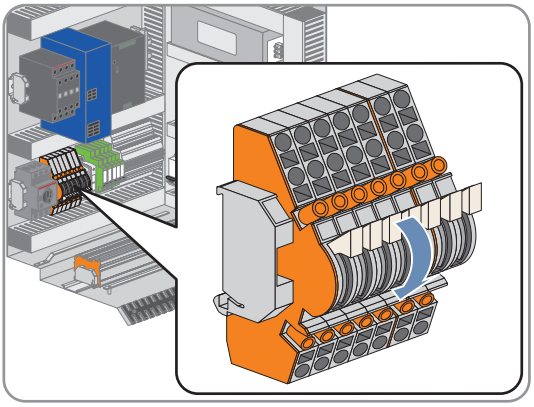
2. If the supply voltage is also to be disconnected downstream from the supply voltage circuit breaker, switch the external circuit breaker of the supply voltage off.

   Tip: The external circuit breaker of the supply voltage is usually located in a subordinate distribution station.

3. Disconnect any additional external voltage.
4. Switch the motor-protective circuit-breakers of the grid monitoring off.



5. Open the measurement and disconnect terminals.



6. Ensure that no voltage is present.
7. Cover or isolate any adjacent live components.

7.5 Disconnecting the MV Transformer

Connect and disconnect the AC voltage of the MV transformer

Only a duly authorized person is allowed to connect and disconnect the AC voltage of the MV transformer.

7.5.1 Disconnecting the MV Transformer without Country Package, France

Requirement:

☐ The inverters must be switched off (see Section 7.4.1, page 102).

Procedure:

1. Switch off the transformer panel of the medium-voltage switchgear (see documentation for the medium-voltage switchgear).
2. Ground the transformer panel of the medium-voltage switchgear (see medium-voltage switchgear documentation).
3. Attach magnetic signs indicating the name of the duly authorized person to the transformer panel.
4. Disconnect any additional external voltage.
5. Cover or isolate any adjacent live components.
6. Connect the grounding and short-circuiting equipment to the AC busbars of the inverter.

7.5.2 Disconnecting the MV Transformer with Country Package, France

Requirement:

☐ The inverters must be switched off (see Section 7.4.1, page 102).

Procedure:

1. Remove the keys on the DC switchgears of the disconnected inverters.
2. Insert the keys into the respective key switches on the key box and turn clockwise. This will unlock the key for the transformer panel of the medium-voltage switchgear.
3. Turn the key for the transformer panel of the medium-voltage switchgear on the key box anticlockwise and remove.
4. Insert the key into the key switch on the transformer panel of the medium-voltage switchgear and turn clockwise (see medium-voltage switchgear documentation).
5. Switch off the transformer panel of the medium-voltage switchgear (see documentation for the medium-voltage switchgear).
6. Ensure that no voltage is present.
7. Ground the transformer panel of the medium-voltage switchgear (see medium-voltage switchgear documentation).
8. Attach magnetic signs indicating the name of the duly authorized person to the transformer panel.
9. Connect the grounding and short-circuiting equipment to the AC busbars of the inverter.
10. Remove the key for the grounding switch from the transformer panel of the medium-voltage switchgear. This allows the transformer locking device on the MV transformer to be unlocked and removed, e.g. for maintenance work.
11. Disconnect any additional external voltage.
12. Cover or isolate any adjacent live components.

7.6 Disconnecting the MV Power Station

Only when the entire MV Power Station has been disconnected will you be able to work on the devices of the MV Power Station without risk.

Depending on how the PV power plant is designed, the automatic reconnection function has to be deactivated in the superordinate MV Power Station with order option "Cascade control".

Procedure:

1. Disconnect the inverter (see Section 7.4, page 102).
2. Disconnect the MV transformer (see Section 7.5, page 103).
3. Deactivate the automatic reconnection function, if the MV Power Station has been delivered with the order option "Cascade control".
   - Turn the rotary switch on the control device to the position "On-site operation".

- Press the confirmation button and the automatic button simultaneously on the control device.
  ☑ The green LED **OFF** next to the automatic button starts glowing.
- Change the control to **LOCAL** in the medium-voltage switchgear (see documentation for the medium-voltage switchgear).

4. Switch off and ground the ring circuit of the medium-voltage switchgear (see documentation for the medium-voltage switchgear).
5. Disconnect the supply voltage of the station subdistribution (see Section 7.3, page 101).
6. Disconnect the MV Power Station from the utility grid at the higher-level medium-voltage switchgear (see documentation for the medium-voltage switchgear). Always observe the five safety rules.
7. Disconnect any additional external supply voltages.
8. Cover or isolate any adjacent live components.

7.7 Reconnecting the MV Power Station

Depending on how the PV power plant is designed, the automatic reconnection function has to be activated in the superordinate MV Power Station with order option "Cascade control".

Procedure:

1. Reconnect the MV Power Station from the utility grid at the higher-level medium-voltage switchgear (see documentation for the medium-voltage switchgear).
2. Unground and switch on the ring circuit of the medium-voltage switchgear (see documentation for the medium-voltage switchgear).
3. Reactivate the automatic reconnection function, if the MV Power Station has been delivered with the order option "Cascade control":
   - Turn the rotary switch on the control device to the position "Remote operation".
   - Press the confirmation button and the automatic button simultaneously on the control device.
     ☑ The red LED **ON** next to the automatic button starts glowing.
   - Change the control to **REMOTE** in the medium-voltage switchgear (see documentation for the medium-voltage switchgear).
4. Reconnect the supply voltage of the station subdistribution (see Section 7.10, page 107)
5. Reconnect any additional external supply voltages.
6. Reconnect the MV transformer (see Section 7.8, page 105).
7. Reconnect the inverter (see Section 7.9, page 106).

7.8 Reconnecting the MV Transformer

To connect the MV transformer, the medium-voltage switchgear must be switched on.

i Connect and disconnect the AC voltage of the MV transformer

Only a duly authorized person is allowed to connect and disconnect the AC voltage of the MV transformer.

7.8.1 Connecting the MV Transformer without Country Package, France

1. Unground (see documentation for the medium-voltage switchgear).
2. Switch the transformer panel and the ring circuit of the medium-voltage switchgear on (see documentation of the medium-voltage switchgear).

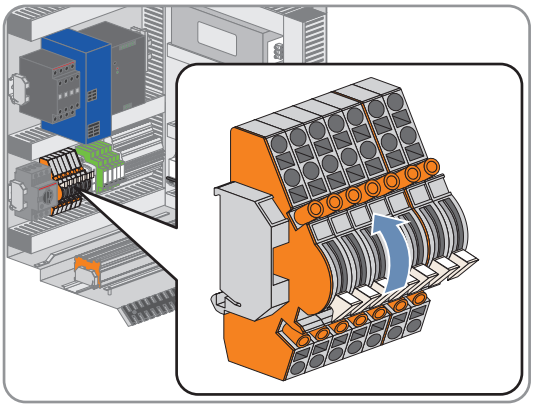
7.8.2 Connecting the MV Transformer with Country Package, France

1. If the transformer clamping unit of the MV transformer has been removed, reattach the transformer clamping unit, lock with the key and remove the key.
2. Insert the key for the transformer clamping unit into the key switch for the grounding switch on the transformer panel of the medium-voltage switchgear and turn clockwise.
3. Switch the transformer panel and the ring circuit of the medium-voltage switchgear on (see documentation of the medium-voltage switchgear).
4. Turn the key of the transformer panel of the medium-voltage switchgear anticlockwise and remove.
5. Insert the key into the key switch for the transformer panel of the medium-voltage switchgear on the key box and turn clockwise.
6. Turn the keys for inverter 1 and inverter 2 anticlockwise and remove.
7. Insert the keys into the DC switchgears of the inverters and turn clockwise.

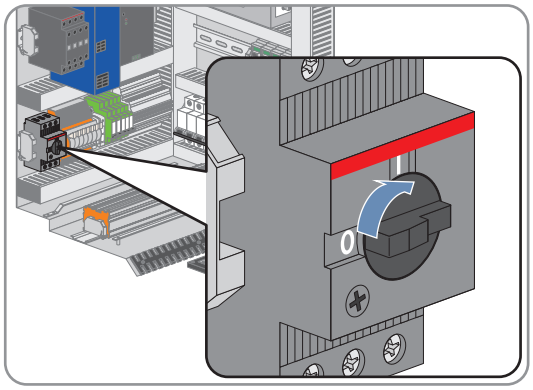
7.9 Reconnecting the Inverter

7.9.1 Reconnecting the Supply Voltage and External Voltages

1. Close the measurement and disconnect terminals.



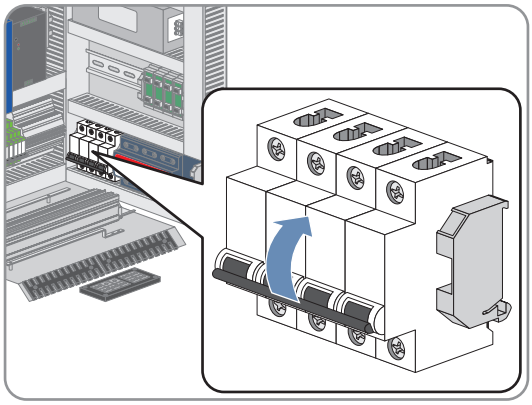
2. Switch on the motor-protective circuit-breakers of the grid monitoring.



3. Connect any additional external voltage.
4. If the supply voltage has been disconnected downstream from the circuit breaker, switch the external circuit breaker of the supply voltage on.

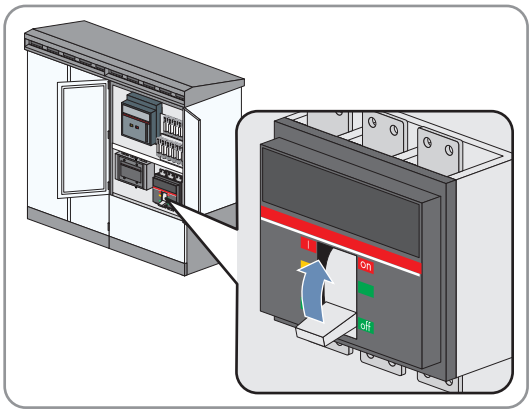
   Tip: The external circuit breaker of the supply voltage is usually located in a subordinate distribution station.

5. If the supply voltage has been disconnected upstream from the circuit breaker, switch the circuit breaker of the supply voltage on.



7.9.2 Reconnecting the AC Side

1. Reconnect the supply voltage and external voltages (see Section 7.9.1, page 106).
2. Reconnect the AC voltage of the MV transformer (see Section 7.8, page 105).
3. Switch on the AC disconnection unit in the inverter.



7.9.3 Reconnecting the DC Side

1. Insert all fuses and disconnection blades into all fuse holders of the inverter. Use an LV/HRC fuse extractor.
2. Screw on the protective covers over the fuses (torque: 5 Nm).
3. Switch on the DC voltage in the DC main distribution or DC subdistribution (see documentation of the main or subdistribution).

7.9.4 Restarting the Inverter

- Turn the key switch to **Start**.

7.10 Reconnecting the Supply Voltage of the Station Subdistribution

1. In case the transformer for internal power supply has been disconnected, switch on the transformer protective device.
2. Switch on the main switch of the supply voltage **Voltage Supply Power Outlet**.
3. Switch on the circuit breakers of the inverters **Voltage Supply SC1** and **Voltage Supply SC2**.
4. Switch on the circuit breaker of the Communit and lighting **Voltage Supply Lighting/Communit**.
5. Switch on the circuit breaker of the optional fans **Fan**.
6. Switch on the circuit breaker of the outlet **Socket**.
7. Switch on any additional supply voltages.

8 Operation

The information in the following sections affect the inverters only. Information on the operation of further optional devices of the MV Power Station, such as the medium-voltage switchgear or the control device for cascade control, can be found in the documentation of the respective device.

8.1 Safety during Operation

⚠ WARNING

Danger to life due to arc fault caused by fault in the medium-voltage switchgear

If there is a fault in the medium-voltage switchgear, arc faults may occur during operation of the product which can result in death or serious injuries. If arc faults occur in the medium-voltage switchgear, the pressure evacuates under the compartment of the medium-voltage switchgear.

- Only perform work on the medium-voltage switchgear when it is in a voltage-free state.
- Only perform switching operations on the medium-voltage switchgear from the service platform.
- Do not touch or access the roof of the medium-voltage switchgear when medium voltage is connected.
- When switching operations are performed, all persons that are not on the service platform have to keep a safe distance from the product.
- All work and switching operations on the medium-voltage switchgear must only be performed by qualified persons wearing adequate personal protective equipment.

NOTICE

Operation failure of the PV power plant due to incorrectly set parameters

If the parameter settings for grid management services are incorrect, the PV power plant may not be able to meet the requirements of the grid operator. This can involve yield losses and the inverter may have to be disconnected by the grid operator.

- When setting the modes of grid management services, ensure that the control procedures agreed with the grid operator are parameterized.
- If the inverter is operated with a Power Plant Controller, ensure that the mode **WCtlCom** for active power limitation and the mode **VArCtlCom** for reactive power control are selected in the inverter.

8.2 Displaying Operating Data

8.2.1 Displaying Operating Data via the User Interface

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Data > Devices**.
3. Select  .
   ☑ A list of the existing device types appears.
4. Select the desired device type.
   ☑ A list appears containing all existing devices of this type.
5. Select the desired device from the list.
6. Select the tab **Instantaneous values**.

8.2.2 Displaying the Operation Data via Sunny Portal

8.2.2.1 Registering the Inverter in Sunny Portal

Automatic PV system identifier

In general, you do not have to change the preset number in the field **PV system identifier**. Sunny Portal uses this number to uniquely identify the PV power plant. If you have not yet registered the PV power plant in Sunny Portal, the predefined PV system identifier will be automatically entered in Sunny Portal after the first successful data upload. Sunny Portal sends the login data to the e-mail address you have entered in the field **Operator e-mail**. After this, your PV power plant is registered in Sunny Portal.

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > Data transmission**.
3. Enter the name of your PV system in the field **PV system name**. This name will be displayed as the name of the PV system in Sunny Portal.
4. Set the data transmission frequency (see Section 8.3.2, page 110).
5. Select **yes** in the field **Use Sunny Portal**.
6. If the PV system is already registered in Sunny Portal, adapt the PV system identifier in the field **PV system identifier** (see Section 8.2.2.2, page 109).
7. Enter your e-mail address in the field **Operator e-mail**. Sunny Portal will send the access data to this e-mail address.
8. Select the button [**Save**].
9. Select **Sunny Central > Info**.
10. Select [**Register**] in the field **Last Sunny Portal registration**. The Sunny Portal password will be sent to the e-mail address you have entered.

8.2.2.2 Adjusting the PV System Identifier for Sunny Portal

Sunny Portal identifies the inverter via the PV system identifier. In the following cases, you will need to adjust the PV system identifier of the inverter:

- Data of the PV power plant has already been sent to Sunny Portal via another communication unit.
- The set PV system identifier of the communication unit has been reset.
- The communication unit has been replaced.

Procedure:

1. Log into Sunny Portal (www.SunnyPortal.com).
2. Select **Configuration > PV system properties**.
3. Copy the PV system identifier to the clipboard.
4. Log into the user interface (see Section 12.8.1, page 177).
5. Select **Sunny Central > Settings > Data transmission**.
6. Delete the content of the **PV system identifier** field.
7. Paste the PV system identifier from the clipboard into the **PV system identifier** field.
8. Select the button [**Save**].

8.2.2.3 Deleting the Sunny Portal Buffer

You can delete the data on the internal ring buffer.

Procedure:

1. Log into the user interface as an installer (see Section 12.8.1, page 177).
2. Select **Sunny Central > Info**.
3. Select the button [**Delete**] in the field **Sunny Portal Buffer Load**.

8.3 Saving Operating Data

8.3.1 Reducing Storage Capacity by Averaging

The communication unit can average the data over a defined time period. This helps to compress the data of the connected devices so that it occupies less memory space in the communication unit.

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Recording**.
3. In the field **Averaging over**, select the time period over which the communication unit is to calculate the average.
4. Select the button [**Save**].

8.3.2 Setting the Data Transmission Frequency

The communication unit can transmit the data to Sunny Portal or an external FTP server. You can set how often and at what interval data will be sent by the communication unit. All data upload settings relate to both data upload to Sunny Portal and data upload to an external FTP server.

If the data transmission to Sunny Portal or the external FTP server fails, the communication unit will make further attempts to transmit the data.

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > Data transmission**.
3. Select the upload frequency and time window in the field **Upload frequency per time window**.
4. Select the maximum number of upload attempts in each time window in the field **Maximum number of upload attempts per time window**.
5. Select the button [**Save**].

8.3.3 Downloading Operating Data Using the FTP Server

8.3.3.1 Defining Read and Write Access Rights

The communication unit is equipped with an integrated FTP server. You can use the FTP server to access the data of the communication unit. The data is available for view and download in CSV or XML format. In order to use the FTP server, you must first assign read and write access rights for the FTP server on the communication unit.

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > Security**.
3. Select an option in the field **FTP server**:

Option	Explanation
Read/write	You have read and write access rights on the integrated FTP server.

Option	Explanation
Read only	You have read access rights only on the integrated FTP server.
Off	The integrated FTP server is deactivated.

4. Select the button [**Save**].

8.3.3.2 Accessing the FTP Server via the Web Browser

You can log into the FTP server of the communication unit as either "user" or "installer".

Stored user name and password in the web browser

After you have accessed the FTP server of the communication unit with a web browser, user name and passwords can be saved in the browser cache.

- Clear the web browser cache to prevent unauthorized access to the FTP server of the communication unit.

Procedure:

1. Start your web browser.
2. Enter the FTP address of the communication unit with your user name and password as follows: ftp://[user name]:[password]@[IP address]

Example: entering the FTP address

If you want to log into the communication unit with IP address 192.168.100.2 and your user name is "user" and password "1234", the correct FTP address is ftp://user:1234@192.168.100.2

3. Press the enter key.

8.3.3.3 Activating Automatic Data Transmission via FTP Push

The communication unit is equipped with an FTP push function. With this function, the data collected from your PV power plant can be uploaded as an XML file to a local FTP server.

Option	Explanation
Yes	Authentication is needed for the FTP server.
No	No authentication is required.

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > Data transmission**.
3. In the field **Use FTP-Push service**, select **yes**.
4. In the field **FTP server**, enter the URL and port of the FTP server.
5. In the field **Upload directory**, specify the folder on the FTP server to which the data is to be saved.
6. In the field **Use authentication**, select an option.
7. Enter the data of your FTP server in the fields **User name** and **Password**.
8. Set the data transmission frequency (see Section 8.3.2, page 110).
9. To test the FTP push function, select the button [**testing**] in the field **Test FTP connection**.
   ☑ A test file is sent to the FTP server.
   ✖ No test file is sent to the FTP server?
   - Ensure that the address of the FTP server and the upload directory are correct.

- Repeat the FTP connection test.
- If an error occurs, contact your network administrator.

10. Select the button [**Save**].

8.3.4 Downloading Operating Data via HTTP Download

8.3.4.1 Downloading Data in XML Format

You can download the data collected by the communication unit via HTTP download. This function enables manual download of your collected PV system data in CSV or XML format to your computer.

Requirement:

☐ Averaging must be activated (see Section 8.3.1, page 110).

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Recording**.
3. In the field **Format**, select the option **XML**.
4. In the field **Download**, select the required month. The data of the last twelve months is available for download via the user interface.
5. Select the button [**Download**].
6. Choose the save location.
7. Select the button [**Save**].

8.3.4.2 Downloading Data in CSV Format

Data saved in CSV format can be automatically imported into tables (e.g. in Microsoft Excel). The configured separator and end of line characters are used to structure the data.

Requirement:

☐ Averaging must be activated (see Section 8.3.1, page 110).

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Recording**.
3. In the field **Format**, select the option **CSV**.
4. Select [**Configure**].
5. Select the desired format of the file name in the field **Filename format**.
6. In the field **Create column headers**, select an option:

Option	Explanation
Yes	A header is added to the CSV file.
No	No header is added to the CSV file.

7. Select an option in the field **End-of-line character**.

Option	Explanation
CRLF (Windows)	Control character used in Windows to separate lines in a CSV file.

Option	Explanation
LF (Unix/Linux)	Control character used in Linux to separate lines in a CSV file.
CR (Mac)	Control character used in Macintosh to separate lines in a CSV file.

8. In the field **Separator character** , select the separator character to be used to separate content within the CSV file. Tip: If you intend to import CSV data into Microsoft Excel for evaluation, choose **Comma** as the separator.
9. In the field **Number format**, select the desired number format. Tip: If you intend to import CSV data into Microsoft Excel for evaluation, select **#.##** as the number format.
10. In the field **Timestamp format**, select the desired time format.
11. In the field **Format of the status channels**, select an option:

Option	Explanation
Numeric	Status information on the inverter is displayed in numeric format.
Plain text	Status information on the inverter is displayed as text.

12. Select the button [**Save**].
13. In the field **Download**, select the required month. The data of the last twelve months is available for download via the user interface.
14. Select the button [**Download**].
15. Select the button [**Save**].
16. Choose the save location.
17. Select the button [**Save**].

8.3.5 Saving Operating Data on a Memory Card

8.3.5.1 Information on Saving Data on a Memory Card

You can save all the data collected from the inverter to a memory card. The save-to-memory-card feature is disabled by default. If a memory card is inserted into the slot of the communication unit and data storage on external storage media is enabled, the communication unit will copy all data from the internal ring buffer to the external SD memory card. The communication unit continues to store data on the memory card for as long as the memory card is inserted in the slot. The communication unit creates a folder on the memory card. The name of the folder is "SC-COM_[SerialNumber]". [SerialNumber] designates the serial number of the respective communication unit. In this folder, the communication unit creates a new subfolder for each day. Each subfolder contains all the data collected by the communication unit. When the memory card has reached its capacity, the LED **H5** glows red and the communication unit ceases to store data on the memory card. Replace the memory card or reformat it on the computer.

i Data loss if memory card is removed

Do not remove the memory card while the communication unit is in process of storing data. This can damage the file system of the memory card and lead to data loss. Depending on the amount of data, the write process can take some time.

8.3.5.2 Inserting the Memory Card

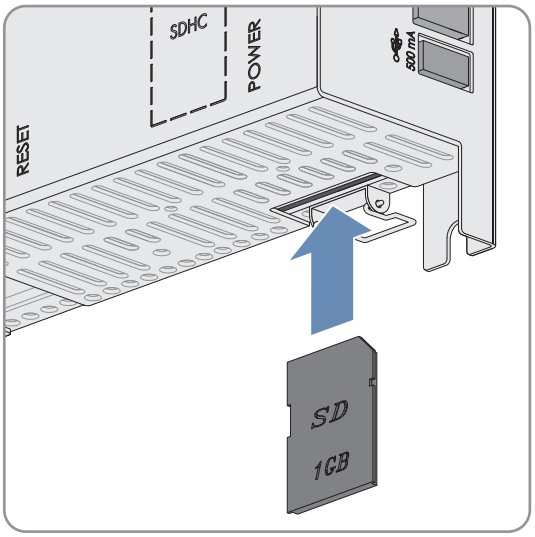
⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

- Switch off the inverter and wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Disconnect the inverter (see Section 7, page 98).

Procedure:

- Insert the memory card in the slot of the communication unit.



8.3.5.3 Enabling Data Storage on the Memory Card

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > Security**.
3. To activate data storage to the memory card, select the option **Enabled** in the field **External memory**.
4. To deactivate data storage to the memory card, select the option **Disabled**.
5. Select the button [**Save**].

8.3.5.4 Displaying the Memory Capacity Available on the Memory Card

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Info**.
3. In the field **Sunny Portal Buffer Load**, you can see the space available in the internal ring buffer.
4. In the field **SD card memory capacity**, you can see the space available on the memory card.

8.4 Updating the Firmware

8.4.1 Automatic Update

If the communication unit has access to Sunny Portal, you can select automatic update of the firmware. The communication unit checks whether a new firmware version is available every time data is transmitted to Sunny Portal. If a new firmware update is available, the communication unit will download the firmware update from the Internet and install it at night between 1:00 a.m. and 4:00 a.m (time set on the inverter). The automatic firmware update function is disabled by default.

Requirement:

☐ Connection to Sunny Portal must be established (see Section 8.2.2, page 109).

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > Data transmission**.
3. In the field **Automatic firmware update**, select the option **yes**.
4. Select the button [**Save**].

8.4.2 Update via User Interface

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Info**.
3. Select the button [**Refresh**] in the field **VersionFirmware**.

8.5 Changing the Insulation Monitoring

8.5.1 Insulation Monitoring with GFDI and Insulation Monitoring Device

8.5.1.1 Safety with insulation monitoring with GFDI and insulation monitoring device

⚠ DANGER

Danger to life from electric shock due to live voltage

High voltages are present in the conductive components of the inverter. Touching live components results in death or serious injury due to electric shock.

- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Wear suitable personal protective equipment for all work on the product.
- All work must be carried out in accordance with this document. All safety information must be observed.
- Do not touch any live components of the inverter or the medium-voltage grid. Comply with all applicable safety regulations for handling medium-voltage grids.

Ground-fault monitoring with GFDI does not provide protection from personal injury.

The order option "GFDI and insulation monitoring device" allows you to manually switch the PV power plant from grounded operation to insulated operation. To ensure that there is no insulation error on the grounded terminal, an insulation measurement is carried out. After switching to insulated operation, the insulation monitoring device checks all poles of the PV power plant for potential insulation errors. Switching to insulated operation is useful for performing maintenance or service work on or near the PV power plant (e.g. cutting the grass) or for checking the status of the insulation at regular intervals. After completion of the maintenance work, the PV power plant must be switched back to grounded operation.

8.5.1.2 Switching to Insulated Operation

1. Turn the key switch to **Stop**.
2. Wait 15 minutes before opening the inverter. This will ensure that the capacitors are discharged.
3. Disconnect the circuit breaker of the GFDI manually.
4. Close the inverter.

5. Turn the key switch to **Start**.
   ☑ The insulation monitoring device starts collecting data. If the parameter **IsoErrIgn** is set to **On**, the error **3504 – Insulation failure ignored** is displayed.
   ✖ After 15 minutes, the displayed error **3504** does not disappear?
   The insulation is defective.
   - Have the insulation checked and, if necessary, repaired by a qualified person.
   - Acknowledge the error.
6. Log into the user interface (see Section 12.8.1, page 177).
7. Wait a few minutes and then call up the instantaneous value **Riso** on the user interface.
   ☑ The insulation resistance is greater than 45 kΩ. It is safe to enter the PV system.
   ✖ The insulation resistance is less than 45 kΩ?
   There is an insulation error and you must not enter the PV system.
   - Have the insulation checked and, if necessary, repaired by a qualified person.

8.5.1.3 Switching to Grounded Operation

1. Turn the key switch to **Stop**.
2. Wait 15 minutes before opening the inverter. This will ensure that the capacitors are discharged.
3. Manually switch on the GFDI circuit breaker.
4. Close the inverter.
5. Turn the key switch to **Start**.

8.5.2 Insulation Monitoring with Remote GFDI and Insulation Monitoring Device

8.5.2.1 Information on Insulating PV Modules with Remote GFDI and Insulation Monitoring Device

Ground-fault monitoring does not provide protection from personal injury. Ground-fault monitoring and the insulation monitoring device enable the PV array to be switched automatically from grounded operation to insulated operation. To ensure that there is no insulation error on the grounded terminal, an insulation measurement is carried out. After switching to insulated operation, the insulation monitoring device checks all poles of the PV array for potential insulation errors. Switching to insulated operation is useful for performing maintenance or service work near the PV array (e.g. cutting the grass) or for checking the status of the insulation at regular intervals.

8.5.2.2 Switching to Insulated Operation

1. Log into the user interface (see Section 12.8.1, page 177).
2. Set the parameter **RemMntSvc** to **On**.

☑ The insulation monitoring device starts collecting data. If the parameter **IsoErrIgn** is set to **On**, the error **3504 - Insulation failure ignored** is displayed.

✖ After 15 minutes, the displayed error **3504** does not disappear?

The insulation is defective.

- Have the insulation checked and, if necessary, repaired by a qualified person.
- Acknowledge the error.

8.5.2.3 Switching to Grounded Operation

1. Log into the user interface (see Section 12.8.1, page 177).
2. Set the parameter **RemMntSvc** to **Off**.

8.6 Deleting the Device Description

Whenever you replace a device in your PV power plant, the descriptions of the existing devices need to be deleted so that the communication unit is able to detect new devices.

Procedure:

1. Log into the user interface as an installer (see Section 12.8.1, page 177).
2. Select **Sunny Central > Info**.
3. Select the button [**Delete device descriptions**].

8.7 Sending a ZIP File with Service Information

In order to help you quickly and effectively, a ZIP file containing service information may be required. This ZIP file can be downloaded from the user interface. The files are protected with a service password.

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Info**.
3. Select [**Create service information**].
   ☑ A dialog box for downloading the ZIP file is opened.
4. Save the ZIP file on the computer.
5. Send the ZIP file to us (see Section 17, page 264).

9 Troubleshooting

9.1 Safety during Troubleshooting

⚠ DANGER

Danger to life from electric shock due to high voltages on the product

High voltages can be present on the product under fault conditions. Touching live components results in death or serious injury due to electric shock.

- Observe all safety information when working on the product.
- Wear suitable personal protective equipment for all work on the product.
- If you cannot remedy the disturbance with the help of this document, contact the Service (see Section 17 "Contact", page 264).

9.2 Troubleshooting in the Medium-Voltage Compartment

Error	Cause and corrective measure
Supply voltage is not present.	If a transformer for internal power supply is present: The transformer for internal power supply does not supply voltage. **Corrective measures:** • Ensure that the transformer for internal power supply is working (see error "The transformer for internal power supply does not supply voltage.").
	If no transformer for internal power supply is present: External supply voltage is not present. **Corrective measures:** • Ensure that the external supply voltage is present.
	The main breaker has tripped. **Corrective measures:** • Ensure that the main breaker is intact.

Error	Cause and corrective measure
The transformer for internal power supply does not supply voltage.	The transformer circuit breaker has tripped. **Corrective measures:** • Ensure that the nominal current on the primary side of the transformer for internal power supply is correctly set. • Switch the transformer circuit breaker back on.
	The transformer for internal power supply is defective. **Corrective measures:** • Replace the transformer for internal power supply. Contact the Service (see Section 17, page 264).
	The EMC filtering device is defective. **Corrective measures:** • Replace the EMC filtering device. Contact the Service (see Section 17, page 264).
	The cabling is damaged. **Corrective measures:** • Ensure that the cabling is intact.
The lighting in the medium-voltage compartment is not working.	The lamps are defective. **Corrective measures:** • Replace the lamps.
	The circuit breaker has tripped. **Corrective measures:** • Check whether apparent damage is visible in the corresponding electrical circuit. If any damage is present, remove it. • Switch the circuit breaker back on.
	The voltage supply of the MV Power Station failed. **Corrective measures:** • Ensure that the supply voltage is present (see error "Supply voltage is not present").

Error	Cause and corrective measure
The fans do not start up.	The required temperature has not been reached. **Corrective measures:** • To check the function of the fans, turn down the thermostat. ☑ The fans start up.
	The circuit breaker has tripped. **Corrective measures:** • Check whether apparent damage is visible in the corresponding electrical circuit. If any damage is present, remove it. • Switch the circuit breaker back on.
	The fans are defective. **Corrective measures:** • Replace the fans. Contact the Service (see Section 17, page 264).
	The voltage supply of the MV Power Station failed. **Corrective measures:** • Ensure that the supply voltage is present (see error "Supply voltage is not present").
	The cabling is damaged. **Corrective measures:** • Ensure that the cabling is intact.
The HV/HRC fuse has tripped.	The HV/HRC fuse is outdated. **Corrective measures:** • Replace all out-of-date fuses (see documentation of the medium-voltage switchgear).
	An error occurred on the MV transformer. **Corrective measures:** • Ensure that no errors are present on the MV transformer (see documentation of the MV transformer).
	The cabling is damaged. **Corrective measures:** • Ensure that the cabling is intact.

Error	Cause and corrective measure
The MV transformer cannot be reconnected.	The MV transformer is defective. **Corrective measures:** • Replace the MV transformer. Contact the Service (see Section 17, page 264).
	There is air in the MV transformer. **Corrective measures:** • Check the protective devices. • Ensure that no air is in the MV transformer. • Refill the oil.
	The MV transformer is too warm. **Corrective measures:** • Read off the temperature of the MV transformer from the contact thermometer. • Allow the MV transformer to cool down. • If the error reoccurs, contact the Service (see Section 17, page 264).
	The relay in the station subdistribution is not working properly. **Corrective measures:** • Ensure that the relay in the station subdistribution is correctly functioning. • Ensure that the cabling of the relay is intact.

9.3 Troubleshooting in the Inverter

9.3.1 Activating Alert in the Event of a Fault

You can be notified by e-mail of events that have occurred. This allows a rapid response to failures in the PV power plant and minimizes downtimes. The alert is deactivated upon delivery.

i Communication unit reports an error-type event after two averaging intervals

The communication unit reports error-type events which have persisted twice as long as the time set for averaging.

Example: If the averaging setting is 15 minutes, the communication unit will report an error once it has existed for longer than 30 minutes.

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Settings > Data transmission**.
3. In the field **Notification active**, select **yes**.
4. Select an option in the field **Multiple Notices (24h/48h)**:

Option	Explanation
yes	You will receive an e-mail immediately upon occurrence of an event. If the event persists after 24 hours and 48 hours, the e-mail will be sent again.
no	You will receive an e-mail once when an event occurs. An e-mail with error-type events is sent after two averaging intervals.

5. In the field **E-mail address**, enter the e-mail address. If an e-mail is to be sent to multiple e-mail addresses, separate the e-mail addresses with commas.

6. In the field **E-mail when**, select the desired event type for which the e-mail is to be sent.
7. Enter the required data in the fields **Mail server (SMTP)**, **Sender e-mail**, **User name** and **Password**.
8. Select the button [**Testing**].
   ☑ A test e-mail will be sent to the specified e-mail address.
   ✖ No test e-mail received?
   - Check whether the test e-mail is in the spam folder.
   - Make sure that the network settings of the communication unit are correct.
   - Make sure the settings of the e-mail server are correct.
9. Select the button [**Save**].

9.3.2 Reading Off Disturbance Messages

9.3.2.1 Reading Off Error Messages via Touch Display

If an error occurs, a warning symbol is shown on the touch display.

Procedure:

- Select the warning symbol.

☑ The touch display lists the error number, waiting time, error message and the necessary corrective measure to eliminate the disturbance.

9.3.2.2 Reading Off Disturbance Messages via the User Interface

1. Log into the user interface (see Section 12.8.1, page 177).
2. To display the error number, select the instantaneous value **ErrNo** in the instantaneous value view.
3. To display the delay time, select the instantaneous value **TmsRmg** in the instantaneous value view.
4. To display the error message, select the instantaneous value **Msg** in the instantaneous value view.
5. To display the corrective measure, select the instantaneous value **Dsc** in the instantaneous value view.

9.3.2.3 Enabling Automatic Read-Out of Events

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select **Sunny Central > Recording**.
3. In the field **Collect automatically fault logs**, select **yes**.
4. Select the button [**Save**].

9.3.2.4 Displaying and Downloading the Event Report

The event report keeps a log of various events, e.g. errors and warnings. All events can be downloaded in a CSV file. Upon delivery, the automatic transfer of the events is deactivated.

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. In order to have the event report of the inverter displayed manually, proceed as follows:
   - Select **Sunny Central > Recording**.
   - In the field **Manually requesting fault memory**, select [**Request**].
   - In the field **Manually requesting event memory**, select [**Request**].
3. Select **Sunny Central > Events**.
4. To download the events as CSV file, carry out the following steps:

- Select the button [**Download**].
- Choose the save location.
- Select the button [**Save**].

9.3.3 Acknowledging Disturbance Messages

9.3.3.1 Acknowledging Disturbance Messages via the Key Switch

Dealing with disturbances

Disturbance messages should only be acknowledged once the underlying causes have been eliminated.

If the causes of the disturbance have not been eliminated, the disturbance will still be detected after acknowledgment and the disturbance message will reappear.

Procedure:

1. If an insulation error has occurred, switch the insulation monitoring device back on.
2. Turn the key switch switch to **Stop** and then back to **Start** after two seconds.

9.3.3.2 Acknowledging Disturbance Messages via the User Interface

Dealing with disturbances

Disturbance messages should only be acknowledged once the underlying causes have been eliminated.

If the causes of the disturbance have not been eliminated, the disturbance will still be detected after acknowledgment and the disturbance message will reappear.

You will only be able to acknowledge error messages via the user interface after entering the installer password.

Procedure:

1. If an insulation error has occurred, switch the insulation monitoring device back on.
2. Log into the user interface (see Section 12.8.1, page 177).
3. Select the parameter **Ackn** in the device displaying the error, and set to **Ackn**.
4. Select the button [**Save**].

9.3.4 Remedial Action in Case of Disturbances

9.3.4.1 Inverter Behavior in Case of Disturbances

If a disturbance occurs during operation, this may be caused by a warning or an error.

There are two levels assigned to each disturbance which influence the display and system behavior. Only in the case of certain disturbances will the inverter behavior differ depending on the level. The level is increased from 1 to 2 if the disturbance occurs five times within two hours or without interruption for two hours.

Inverter behavior in the disturbance levels 1 and 2:

- **Waiting time**

  The inverter switches to the operating state "Disturbance" and opens the AC contactor and DC switchgear. The inverter does not feed into the grid for the defined waiting time.

  The waiting time specifies how long the disturbance will be shown on the touch display and saved as a disturbance. Once the waiting time has elapsed, the disturbance is no longer shown on the touch display. The inverter then checks whether the cause of the disturbance has been rectified.

  If the cause of the disturbance still exists after the waiting time has expired or the disturbance has been acknowledged, the inverter remains in the operating state "Disturbance".

- **Waiting for acknowledgement**

  The inverter switches to the operating state "Disturbance" and opens the AC contactor and DC switchgear. The inverter does not feed in until the disturbance is acknowledged.

  Once the disturbance has been acknowledged, it is no longer shown on the touch display. The inverter then checks whether the cause of the disturbance has been rectified.

  If the disturbance is no longer pending, it is deleted from the memory. If the cause of the disturbance still exists after the disturbance has been acknowledged, the inverter remains in the operating state "Disturbance".

- **Day change**

  The inverter switches to the operating state "Disturbance" and opens the AC contactor and DC switchgear. The inverter does not feed in.

  The disturbance is automatically reset when the day changes. Once the disturbance has been reset, it is no longer shown on the touch display. The inverter then checks whether the cause of the disturbance has been rectified.

  If the disturbance is no longer pending, it is deleted from the memory. If the cause of the disturbance still exists after the day has changed or the disturbance has been acknowledged, the inverter remains in the operating state "Disturbance".

- **System-specific**

  The inverter switches to the operating state "Disturbance" and opens the AC contactor and DC switchgear. The inverter does not feed in. How long the inverter remains in this state depends on the system-specific influencing factors.

  Once the time has elapsed, the disturbance is no longer shown on the touch display. The inverter then checks whether the cause of the disturbance has been rectified. If the disturbance is no longer pending, it is deleted from the memory. If the cause of the disturbance still exists after the disturbance has been acknowledged, the inverter remains in the operating state "Disturbance".

- **Warning**

  A warning does not affect inverter behavior. The cause of the warning must be determined and remedied.

In the operating state "Disturbance", the touch display shows a warning symbol, error number, waiting time, error message and the required measure to eliminate the disturbance message.

Once the cause of the disturbance has been rectified and the disturbance is no longer displayed, it is deleted from the fault memory. To view previous disturbances after they have been deleted from the fault memory, an event report is filed on the SD memory card. The event report logs the time and type of disturbance. The event report can also be displayed on the user interface.

Depending on the type of disturbance, a reset may be performed. When this happens, the relays are checked and the supply voltage of the control system is switched off. This process takes less than one minute. While the control system is booting, the regular waiting times for grid monitoring are complied with.

9.3.4.2 Explanation of the Error Tables

You will find the following information in the error tables in the following sections:

Error no.	Explanation	S1 (A)	S2 (A)	R (B)	Corrective measures
1301	Left-hand rotating magnetic field is connected.	30 s	Q	–	• Check phase position.
3803	DC current of PV array is too high.	1 min	D	x	• Check DC input current.
0104	Grid voltage is too high.	W	C	–	• Check grid voltage.

Position	Explanation
A	Behavior of the inverter: disturbance level S1, disturbance level S2 • s / min: waiting time • C: system-specific • D: day change • Q: waiting for acknowledgement • W: warning
B	Reset

9.3.4.3 Error Numbers 01xx to 13xx - Disturbance on the Utility Grid

After a grid failure, the inverter monitors the utility grid for a specific period before reconnecting. When the inverter monitors the utility grid after a grid error, the grid monitoring time is complied with. Certain errors, such as grid errors, cause the inverter to shut down. In this case, the instantaneous value **TmsRmg** indicates the time for which the inverter monitors the utility grid before reconnecting. This grid monitoring time can be defined in parameter **GdErrTm**.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
0103*	Grid voltage is too high. Overvoltage detected by redundant monitoring.	30 s	30 s	–	• Check the grid voltage. • Check grid connections. • Check stability of the utility grid. • Make sure the external fuses work properly. • Make sure the AC cable connections are tight.
0104*	Grid voltage is too high. Overvoltage detected by standard monitoring.	C	C	–	
0203*	Grid voltage is too low. Undervoltage detected by redundant monitoring.	30 s	30 s	–	
0204*	Grid voltage is too low. Undervoltage detected by standard monitoring.	30 s	30 s	–	
0205*	Grid synchronization not possible	30 s	30 s	–	

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
0404*	Frequency change per second too high for grid operation	30 s	30 s	–	–
0502*	Power frequency is too low. Power frequency disturbance detected by standard monitoring.	30 s	30 s	–	• Check power frequency. • Check the display of the grid monitoring relay. • Make sure the fuses in the load circuit function properly.
0503*	Power frequency is too high. Power frequency disturbance detected by standard monitoring.	30 s	30 s	–	
0504*	Power frequency is too low. Power frequency disturbance detected by redundant monitoring.	30 s	30 s	–	
0505*	Power frequency is too high. Power frequency disturbance detected by redundant monitoring.	30 s	30 s	–	
0506*	The inverter has detected a stand-alone grid and has disconnected from the utility grid.	W	W	–	• Check power frequency.
0801*	One line conductor of the utility grid has failed.	30 s	30 s	–	• Check the grid voltage. • Make sure the external fuses work properly. • Make sure the AC cable connections are tight.
0802*					
1301	Left-hand rotating magnetic field is connected.	30 s	Q	–	• Check phase position. • Make sure all fuses are switched on.
1500	The conditions for grid reconnection have not yet been reached after a grid error.	W	W	–	• Check the power frequency and grid voltage.

* Depending on the parameterization, the disturbance message may have to be acknowledged manually.

9.3.4.4 Error Numbers 34xx to 40xx - Disturbance on the PV Array

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
3403	PV array voltage is too high.	15 min	30 min	–	• Check the DC voltage. • Check the module wiring and system design.
3404	Open-circuit voltage is too high. Disturbance detected by standard monitoring.	15 min	30 min	–	
3406	The DC voltage is too high.	15 min	30 min	–	

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
3501	The insulation monitoring device has measured a too low grounding resistance.	C	C	–	• Check the PV array for ground faults.
3502	The GFDI has tripped.	C	C	–	• Check the PV array for ground faults.
3504	The insulation monitoring device has detected an insulation error. If the parameter **IsoErrIgn** is set to **On**, this error is ignored.	W	W	–	• Check the PV array for ground faults.
3507	A ground fault has occurred on the ungrounded terminal of the PV array.	Q	Q	–	• Check the PV array for ground faults.
3510	The inverter has detected an insulation error on the inverter bridge.	Q	Q	–	• Check the PV array for ground faults.
3511	The inverter has detected an insulation error.	W	W	–	• Check the PV array for ground faults.
3512	The Remote GFDI has detected a permanent ground fault.	Q	Q	–	• Check the PV array for ground faults.
3515	A ground fault detected by Soft Grounding has been ignored.	W	W	–	• Check the PV array for ground faults.
3517	Insulation measuring is being performed.	W	W	–	–
3520	An insulation fault has occurred and has been fixed.	W	W	–	–
3601	Leakage current to ground has occurred in the PV array or the threshold defined in parameter **RisoCtlWarn** has been reached.	W	W	–	• Check the grounding and equipotential bonding. • Check the module wiring and system design. • Check the parameter **RisoCtlWarn**.
3803	The PV array current is too high.	1 min	D	–	• Check the DC input current. • Check the module wiring and system design.
4003	Reverse currents detected in the PV array or DC connection polarity reversed.	30 s	Q	–	• Check the PV modules for short circuits. • Check the module wiring and system design. • Check the DC terminals for correct polarity. • Check the functionality of the entire string.

9.3.4.5 Error Numbers 6xx to 9xx - Disturbance on the Inverter

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
6002	Calibration data cannot be loaded.	Q	Q	–	• Contact SMA Service Line.
6113	Data block cannot be loaded from EEPROM or channel list has changed (e.g. after firmware update)	W	W	–	• Contact SMA Service Line.
6115	Setting of hardware thresholds on D/A converters is not possible.	5 min	5 min	x	• Contact SMA Service Line.
6116	Real-time clock has not initialized.	W	W	–	• Contact SMA Service Line.
6117	Device address not recognized.	5 min	5 min	x	• Contact SMA Service Line.
6119	Data structure for communication between operation control unit and digital signal processor is invalid.	5 min	5 min	x	• Contact SMA Service Line.
6120	Watchdog tripping error	30 s	W	–	• Contact SMA Service Line.
6121	No response from watchdog	30 s	W	–	• Contact SMA Service Line.
6122	Ten internal monitoring errors have occurred in succession.	W	5 min	–	• Contact SMA Service Line.
6128	General error	5 min	5 min	x	• Contact SMA Service Line.
6404	Overcurrent at line conductor L1, L2 or L3	C	Q	x	• Contact SMA Service Line.
6405	Overvoltage in the DC link of the inverter bridge	30 s	5 min	–	• Contact SMA Service Line.
6410	24 V supply voltage is invalid.	5 min	5 min	x	• Contact SMA Service Line.
6417	15 V supply voltage is invalid.	5 min	5 min	x	• Contact SMA Service Line.
6418	Overtemperature of the inverter bridge	5 min	15 min	–	• Contact SMA Service Line.
6422	Inverter bridge in undefined state	30 s	5 min	–	• Contact SMA Service Line.
6423	Overtemperature in the switch cabinet	5 min	30 min	–	• Contact SMA Service Line.
6425	Synchronization error with utility grid	30 s	5 min	x	• Contact SMA Service Line.
6427	Sensor error of DC voltage measurement	30 s	C	–	• Contact SMA Service Line.
6440	The MV transformer is no longer hermetically sealed.	30 s	5 min	–	• Check the MV transformer.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
6441	Sensor error during measurement of DC voltage	30 s	30 s	–	• Contact SMA Service Line.
6443	Unspecified error in digital signal processor	30 s	–	x	• Contact SMA Service Line.
6447	Self-test of inverter bridge failed	Q	Q	–	• Contact SMA Service Line.
6448	Insulation monitoring provides non-permitted values	W	W	–	• Check insulation monitoring.
6451	Measured AC voltage of the inverter is less than utility grid voltage.	W	W	–	• Contact SMA Service Line.
6452	Measured AC voltage of the utility grid is less than inverter voltage.	W	W	–	• Contact SMA Service Line.
6453	AC voltage of grid limit monitoring is faulty.	W	W	–	• Contact SMA Service Line.
6454	AC current is faulty.	W	W	–	• Contact SMA Service Line.
6455	AC voltage is faulty.	W	W	–	• Contact SMA Service Line.
6456	Pre-charging circuit of DC link is defective.	W	W	–	• Contact SMA Service Line.
6457	Capacitor self-test has failed.	Q	Q	–	• Contact SMA Service Line.
6461	Insulation monitoring device has not adopted threshold.	15 min	15 min	x	• Check the insulation monitoring device and cabling.
6471	Online capacitor self-test has failed.	Q	Q	–	• Contact SMA Service Line.
6472	Endless loop between online and offline capacitor test	Q	Q	–	• Contact SMA Service Line.
6486	Inadmissible deviations between AC power and DC power has been detected.	W	W	–	–
6487	AC ground fault has been detected.	Q	Q	–	• Check the overvoltage protection. • Contact SMA Service Line.
6501	Interior temperature of inverter is too high.	30 s	1 min	–	• Check function of the fans. • Clean the fans. • Clean clogged fan inlets and ventilation plates.
6502	Temperature of inverter bridge is too high.	30 s	1 min	–	
6508	Outside temperature is too high.	30 s	1 min	–	
6512	Minimum operating temperature not reached	W	W	–	–

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
6605	The fast stop was tripped due overtemperature in the switch cabinet.	30 s	1 min	–	• Contact SMA Service Line.
7001	Cable break or short circuit at inverter temperature sensor	W	W	–	• Check the wiring of the temperature sensor. • Contact SMA Service Line.
7002		W	W	–	
7004		W	W	–	
7006		W	W	–	
7501	Interior fan is defective.	W	W	–	• Check function of the fans. • Clean the fans. • Clean clogged fan inlets and ventilation plates.
7502		W	W	–	
7503	Inverter bridge fan is defective.	W	W	–	
7507	Motor-protective circuit breaker of fan has tripped.	W	W	–	
7510	Interior fan is defective.	W	W	–	
7600	Communication between touch display and communication unit is interrupted. The error number appears on the display only.	W	W	–	• Check cabling between touch display and communication unit. • Contact SMA Service Line.
7601	Internal inverter error	30 s	1 min	x	• Contact SMA Service Line.
7602	Internal communication error has occurred or communication is interrupted.	30 s	1 min	x	• Contact SMA Service Line.
7605		30 s	1 min	x	• Contact SMA Service Line.
7704	Faulty switching status of the DC switchgear	30 s	Q	–	• When disconnecting the inverter, check that all motor-driven circuit breaker switches are set to the **OFF** position. If not, set all switches to **OFF**. • Contact SMA Service Line.
7706	The AC disconnection unit is open or was tripped.	30 s	Q	–	• Contact SMA Service Line.
7707	Faulty switching status of the AC disconnection unit	30 s	Q	–	• Contact SMA Service Line.
7708	Faulty switching status of Remote GFDI	W	W	–	• Contact SMA Service Line.
7709	90% of switch cycles of the DC switchgear reached	10 s	10 s	–	• Contact SMA Service Line.
7710	100% of switch cycles of the DC switchgear reached	30 s	30 s	–	• Contact SMA Service Line.

Error no.	Explanation	Inverter behavior			Corrective measures
		S1	S2	R	
7714	Maximum number of GFDI switch cycles reached	30 s	30 s	–	• Replace GFDI.
7801	The surge arrester is defective or the back-up fuse of the surge arrester was tripped.	W	W	–	• Check the surge arrester. • Check the back-up fuse of the surge arrester.
7901	Reverse current has occurred in PV array.	1 min	D	x	• Contact SMA Service Line.
8004	The inverter starts to derate due to overcurrent at the DC switchgear (SMID).	W	W	–	–
8701	External active power setpoints are smaller than 2 mA and therefore invalid. The last valid value or, after a day change, **Pmax** is used. Once valid setpoints are available again, these will be used.	W	W	–	• Contact SMA Service Line.
8702	Several digital active power setpoints are available.	W	W	–	• Contact SMA Service Line.
8703	Power factor of the external reactive power setpoint is invalid.	W	W	–	• Contact SMA Service Line.
8704	External active and reactive power setpoints are invalid.	W	W	–	• Contact SMA Service Line.
9000	Power electronics self-test is running. This message disappears once the self-test is complete.	W	W	–	–
9008	Doors have been opened during operation.	30 s	1 min	–	• Contact SMA Service Line.
9009	Fast stop has tripped.	30 s	30 s	–	• Eliminate error and switch fast stop back on.
9013	This relates to a grid management shutdown. The error is reset by a signal from the grid operator or from the safety system of the grid interconnection point.	30 s	30 s	–	• Eliminate error and switch fast stop back on.
9019	Defective fast stop	30 s	C	–	• Check the fast stop cabling.

9.3.4.6 Displaying Disturbance Messages for Active Power Limitation

The instantaneous value **P-WModFailStt** displays errors or warnings associated with active power limitation.

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select the instantaneous value **P-WModFailStt**.

Display	Cause and corrective measures
Off	No mode for active power limitation has been selected.
OK	A mode for active power limitation has been selected and no error is present.
ComFail	The mode **WCtlCom** has been selected and the expected signal with a valid active power limitation has been absent for at least five minutes. **Corrective measures:** • Ensure that the communication units can be accessed via the Internet. • Ensure that the communication units are connected correctly. • Ensure that the cabling between the communication units is ok.
AnInFail	The mode **WCnstNomAnIn** has been selected and the value measured at the analog input is less than 2 mA. **Corrective measures:** • Make sure the cable is correctly connected to the analog input.
ComInvalid	The mode **WCtlCom** has been selected and there is invalid content in the power setpoint information. **Corrective measures:** • Check the power specification settings.

9.3.4.7 Displaying Disturbance Messages for the Reactive Power Setpoint

The instantaneous value **Q-VArModFailStt** displays errors or warnings relating to the reactive power setpoint.

Procedure:

1. Log into the user interface (see Section 12.8.1, page 177).
2. Select the instantaneous value **Q-VArModFailStt**.

Display	Cause and corrective measure
Off	No mode for specifying the reactive power setpoint has been selected.
OK	A mode for specifying the reactive power setpoint has been selected and no error is present.
ComFail	The mode **VArCtlCom** or **PFCtlCom** has been selected and the expected signal with a valid reactive power setpoint has been absent for at least five minutes. **Corrective measures:** • Ensure that the communication units can be accessed via the Internet. • Ensure that the communication units are connected correctly. • Ensure that the cabling between the communication units is ok.

Display	Cause and corrective measure
AnInFail	The mode **VArCnstNomAnIn** or **PFCnstAnIn** has been selected and the value measured at the analog input is less than 2 mA. **Corrective measures:** • Make sure the cable is correctly connected to the analog input.
ComInvalid	The mode **VArCtlCom** or **PFCtlCom** has been selected and there is invalid content in the power setpoint information. **Corrective measures:** • Check the power specification settings.

10 Maintenance

10.1 Safety during Maintenance

⚠ DANGER

Danger to life from electric shock due to live voltage

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Wear suitable personal protective equipment for all work on the product.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 7.4, page 102).

NOTICE

Damage to the devices due to sand, dust or moisture penetration

Sand, dust or moisture penetration can damage the devices of the MV Power Station or impair their functionality.

- Do not open any devices during a sandstorm, precipitation or when humidity exceeds 95%.
- Only perform maintenance work when the environment is dry and free of dust.
- If the installation, maintenance or commissioning process is interrupted, mount all enclosure parts and close all doors.

NOTICE

Damage to electronic components due to electrostatic discharge

Electrostatic discharge can damage or destroy electronic components.

- Observe the ESD safety regulations when working on the product.
- Wear suitable personal protective equipment for all work on the product.
- Discharge electrostatic charge by touching grounded enclosure parts or other grounded elements. Only then is it safe to touch electronic components.

Maintenance report for maintenance

Maintenance and repair works are to be documented in a maintenance report. The maintenance report can be found in the download area at www.SMA-Solar.com.

10.2 Maintenance Schedule and Consumables

10.2.1 Notes on Maintenance Work

Observance of maintenance intervals ensures trouble-free operation of the MV Power Station.

Adverse ambient conditions and installation in the desert

The location of the system and ambient conditions influence the maintenance intervals. If the MV Power Station is installed in adverse ambient conditions, SMA Solar Technology AG recommends a monthly inspection in order to determine the need for maintenance. The maintenance intervals are to be shortened depending on the determined maintenance requirements. In particular, cleaning work and corrosion protection may be necessary more frequently.

If the MV Power Station is installed in a desert region, the maintenance intervals must be reduced. SMA recommends to check the function of the devices in the MV Power Station after each sandstorm.

Consumables and maintenance materials

Only those consumables and maintenance materials not normally included in the standard equipment of an electrically qualified person are listed. It is taken for granted that standard tools and materials such as torque wrenches, one-contact voltage testers and wrenches will be available for all maintenance operations.

10.2.2 Maintenance Work Every 12 Months

10.2.2.1 Station Container

Required maintenance materials and tools (not included in the scope of delivery):

- ☐ A suitable water-free, temperature-resistant lubricant
- ☐ Talcum, petroleum jelly or wax for maintaining the seals
- ☐ Use touch-up sticks, paint brushes, cans of spray paint or 2K-PUR acrylic paint in the appropriate RAL color to repair small-area surface damage.
- ☐ Use touch-up paint or 2K-PUR acrylic paint in the appropriate RAL color to repair large-area surface damage.
- ☐ Abrasive cloth
- ☐ Degreaser

Maintenance under voltage-free conditions

Task	See
Perform an optical inspection.	Section 10.4.1, page 142
Check whether the protective grids in front of the transformer compartment are intact.	–
Check the doors and structural components of the door frame for damage. Ensure that the doors and locks function properly.	–
Check whether the support feet are securely fixed at the station container and whether the nuts are securely tightened.	–
Check whether the warning labels and circuit diagrams are present, complete and legible.	–
Remove dirt, dust and moisture from the inverter compartment.	–
Check the oil tray and oil drain valves and clean, if necessary. Ensure that the holes in the base of the transformer compartment are free so that oil can drain in case of a leak in the MV transformer.	–

10.2.2.2 Medium-Voltage Compartment

Required maintenance materials and tools (not included in the scope of delivery):

☐ A suitable water-free, temperature-resistant lubricant

☐ Abrasive cloth

Maintenance work with supply voltage present

Task
Clean the medium-voltage compartment.
Clean the ventilation shaft and the ventilation grids on the doors.
Check the function of the fans with order option "+50°C/+55°C".
Make sure that the grounding contacts are securely in place and show no discoloration or corrosion.
Check the function of the doors and hinges and lubricate them.
Check whether the hinges at the service platform of the medium-voltage compartment function properly.
Check the function of the lighting.

10.2.2.3 MV Transformer

Required maintenance material (not included in the scope of delivery):

☐ Thermographic camera

Maintenance under voltage-free conditions

Task	See
Check the tightness of the MV transformer and slightly retighten the screws, if necessary.	Documentation for the MV transformer
For each tap changer, perform a switching test of ten switching cycles across the entire range under voltage-free conditions. This will prevent oil and carbon deposits from accumulating on the converter contacts.	
Remove any rust patches and repaint.	
Check and clean the cable entries, protective device, contact thermometer and control elements.	
Check the contacts of the low-voltage terminals for discoloration. Check whether the protective covers of the low-voltage terminals are present and intact.	
Check whether the contacts of the medium-voltage terminals are intact.	
Clean the insulators.	
Check the terminals for heating as a result of transition resistances using a thermographic camera.	

Task	See
Check the protective devices, contact thermometers, accessories and cabling. Check the function and settings.	Documentation for the MV transformer
Check the torques of the screws.	
Check and lubricate the rubber seals on the cable entries.	
Check the MV transformer for operating noise.	
Check the grounding of the transformer.	
Check the oil temperature.	
Check the oil level. Refill the oil, if necessary.	

10.2.2.4 Medium-Voltage Switchgear

Task	See
Carry out the visual inspection of the general condition (cleanliness, no corrosion, etc.). If required, clean the enclosure and repair corroded surfaces.	–
Check the accessory for completeness and its current state.	–
For order option "Cascade control": check the LEDs on the control device Easergy T200I and ensure that no errors are present.	Documentation for the control device

10.2.2.5 Station Subdistribution

Task
Check that the protective covers of the fuses are securely in place and correct, if necessary.
Check the function of the relay in the safety loop.

10.2.3 Maintenance Work Every 24 Months

10.2.3.1 Station Subdistribution

Task
Clean the inside of the enclosure.

10.2.3.2 Medium-Voltage Switchgear

Maintenance under voltage-free conditions

Task	See
Perform a 12-months maintenance.	Section 10.2.2.4, page 137

Task	See
Check the interlocking function.	Documentation for the medium-voltage switchgear
Check the cable connections and tighten again, if necessary.	
Check the fuses or circuit breakers.	
Check the motor-drive function.	
For order option "Cascade control": read out the event report from the user interface of the control device Easergy T200I and ensure that no errors are present.	Documentation for the control device

10.2.3.3 Low-Voltage Meter (GSE)

Task	See
Checking the optical test output*	Documentation for the low-voltage meter
Performing a creep test*	
Checking the active power measurement*	
Checking the reactive power measurement*	

* The maintenance interval depends on national regulations and standards.

10.2.3.4 Sunny Central

Required maintenance materials and tools:

- ☐ A suitable water-free, heat-resistant lubricant
- ☐ A testing device approved by the manufacturer of the AC disconnection unit, e.g. TT1 by ABB
- ☐ Talcum, petroleum jelly or wax for maintaining the seals
- ☐ Use touch-up sticks, paint brushes, cans of spray paint or 2K-PUR acrylic paint in the appropriate RAL color to repair small-area surface damage.
- ☐ Use touch-up paint or 2K-PUR acrylic paint in the appropriate RAL color to repair large-area surface damage.
- ☐ Use zinc plating with thick-layer passivation to repair damage on the zinc-plated steel frame in the base area, e.g. LZ-09. Observe the relevant instructions of the manufacturer.
- ☐ Abrasive cloth
- ☐ Degreaser
- ☐ A surge arrester testing device approved by the surge arrester manufacturer

Maintenance work depending on the condition of the inverter

Maintenance with DC voltage present

Task	See
Reading off error messages and warnings	Section 9.3.2, page 122
Checking the AC disconnection unit	Section 10.5.10, page 155

Maintenance under voltage-free conditions

Task	See
Performing the visual inspection	Section 10.4.1, page 142

Task	See
Analyzing the temperature indicators	Section 10.5.1, page 146
Cleaning the ventilation plate	Section 10.5.3, page 148
Cleaning the air duct and ventilation grids	Section 10.5.2, page 147
Checking the interior	Section 10.4.2, page 142
Checking the fuses/disconnection blades	Section 10.5.4, page 149
Checking the bolted connections	Section 10.5.5, page 149
Checking the labels	Section 10.5.7, page 151
Checking the inverter surface	Section 10.4.5, page 144

Maintenance work with supply voltage present

Task	See
Checking the DC switchgear	Section 10.5.11, page 156
Checking the fans	Section 10.5.6, page 150
Checking the heating element and the hygrostat	Section 10.5.8, page 153
Checking the function of the UPS	Section 10.5.9, page 154

10.2.4 Maintenance Work Every 6 Years

Medium-voltage switchgear

Maintenance under voltage-free conditions

Task	See
Perform a 12 months-maintenance.	Section 10.2.2.4, page 137
Perform a 24 months-maintenance.	Section 10.2.3.2, page 137
Clean the external elements with a clean, dry cloth.	Documentation for the medium-voltage switchgear
Check that the position indicators (OFF and ON) are aligned.	
Check function of the mechanical drive by means of various electronic circuits.	
Check the general condition of the electrical connections.	–

MV transformer

Task	See
Take an oil sample and have it tested.	Documentation for the MV transformer

10.2.5 Maintenance Work Every 10 Years

Medium-voltage switchgear

Maintenance under voltage-free conditions

Task	See
Perform a 12-months maintenance.	Section 10.2.2.4, page 137
Perform a 24-months maintenance.	Section 10.2.3.2, page 137
Replace the HV/HRC fuses.	Documentation for the medium-voltage switchgear
Replace the voltage indicator.	

10.2.6 Demand-Based Maintenance

10.2.6.1 All Devices

Task	See
Prior to each switching procedure of the medium-voltage switchgear, check the level of the SF6 gas holders.	Documentation for the medium-voltage switchgear
Check the MV transformer for operating noise.	–
Contact the SMA Service Line after each short circuit.	–
Prior to each use of the outlet, check the residual-current device in the station sub-distribution.	–

10.2.6.2 Oil Tray

Task
Regularly check the oil tray for leakages. If necessary, eliminate leakages.
Regularly check the oil tray for dirt contamination. Clean if necessary.
Regularly check the oil separator for dirt contamination. Clean if necessary.
Regularly check the oil tray for water to prevent frost damage. Remove water, if necessary.

10.3 Repair Schedule and Spare Parts

10.3.1 Information on Repair Work

Spare parts

Spare parts can be identified via the reference designation and the circuit diagram. The spare-parts list includes the article numbers of each spare part. For information on a specific article number, contact us (see Section 17 "Contact", page 264).

10.3.2 Demand-Based Repairs

Inverter

Task	Interval
Replace key switch	In case of severe signs of wear
Replace surge arrester	If tripped
Replace labels on the enclosure	If illegible, defective or missing
Replace Remote Switch Unit of the GFDI	Number of switching cycles: 7,000 • Contact SMA Service Line.
Replace GFDI / ABB circuit breaker	After 100 trippings due to short circuit or after number of switching cycles: 7,000 • Contact SMA Service Line.

10.3.3 Repairs every 5 Years

Low-Voltage Meter

Task	See
For order option "Low-voltage meter": replace the battery of the meter UMG 604E from Janitza and check the function of the meter.	Documentation for the low-voltage meter

10.3.4 Repairs every 10 Years

Inverter

Task	Comment
Replace 24 V power supply units	• Contact the Service.
Replace the fans of the AC disconnection unit	• Contact the Service.
Replace exterior key switch, front element and label	• Contact the Service.

Low-Voltage Meter

Task	See
For order option "Country package Italy": replace the battery of the meter E650 from Landis + Gyr and check the function of the meter.	Documentation for the low-voltage meter

10.3.5 Repairs every 13 Years

i Replacement intervals for order option "Q at Night"

The replacement intervals are halved for order option "Q at Night".

Task	Comment
Replace interior fan in the inverter cabinet	• Contact SMA Service Line.
Replace inverter bridge fan	• Contact SMA Service Line.

10.4 General Maintenance Work

10.4.1 Performing the Visual Inspection

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7.6, page 104).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

Procedure:

1. Ensure that there are no foreign materials or objects in or on the MV Power Station and its devices that are flammable or that could otherwise endanger operational safety. If necessary, remove foreign materials and seal any holes to prevent further intrusion.
2. Ensure that there are no objects under the medium-voltage compartment which endanger operational safety in case of arc faults.
3. Ensure that there are no objects under the inverter compartment which prevent the air from circulating.
4. Check whether no visual defects are present on the walls, the roof and the support feet of the devices and station container (e.g. discoloration, dirt, damage, scratches or cracks).

   If visual defects are present, repair these immediately.
5. Check the welded joints on the devices for damage.
   Contact the SMA Service Line if any welded joints are damaged.
6. Check whether the type label of the MV Power Station is present, complete and legible.

10.4.2 Cleaning the Interior

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7.6, page 104).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

Procedure:

1. Remove dirt and dust from the inverter interior and from all devices.
2. Check the interior for leaks.
   If leaks are present, fix them.
3. Remove moisture.

10.4.3 Checking the Seals

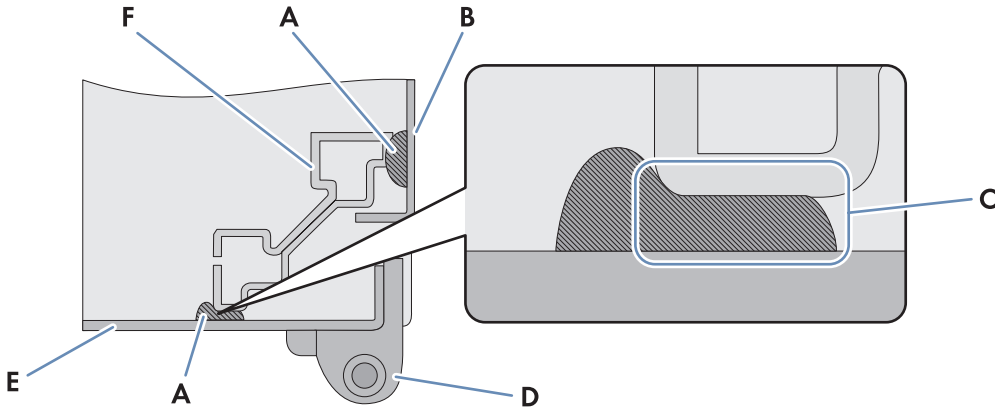


Figure 42: Section drawing with top view of a door seal in the inverter (example)

Position	Designation
A	Seal
B	Side panel
C	Sealing area
D	Hinge
E	Door
F	Frame construction

Required maintenance material (not included in the scope of delivery):

☐ A suitable water-free, heat-resistant lubricant

☐ Talcum, petroleum jelly or wax for maintaining the seals

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7.6, page 104).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

Procedure:

1. Check whether the seals in the sealing area show any damage.
   If seals are damaged, contact us (see Section 17 "Contact", page 264).

2. Apply talcum, petroleum jelly or wax to seals. This will prevent frost damage.
3. After removing the side panels: check whether the side panel seals display any damage in the sealing area.
   If seals are damaged, contact us (see Section 17 "Contact", page 264).

10.4.4 Checking the Latches, Door Stops and Hinges

Required maintenance material (not included in the scope of delivery):

☐ A suitable, water-free and heat-resistant lubricant, e.g. WD40

☐ Non-greasing antifreeze agent, e.g. PS88

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7.6, page 104).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

Procedure:

1. Check whether the doors latch easily. Open and close the doors several times.
   If the doors do not latch easily, lubricate all moving parts of the latch.
2. Check whether the stops hold the doors in place.
   If the doors cannot be arrested, lubricate the door stops.
3. Check whether the door hinges move easily.
   If the door hinges do not move easily, apply lubricant.
4. Lubricate all moving parts and movement points.
5. Tighten any loose screws with the appropriate torque.
6. If the inverter is installed in regions where below-freezing temperatures occur, apply the non-greasing antifreeze to the profile cylinder of the door lock and the key switch in order to protect them from icing up.

10.4.5 Checking the Inverter Surface

Required maintenance material (not included in the scope of delivery):

☐ Abrasive cloth

☐ Degreaser

☐ Use touch-up sticks, paint brushes, cans of spray paint or, alternatively, 2K-PUR acrylic paint in the appropriate RAL color to repair small-area surface damage. Observe the relevant instructions of the paint manufacturer.

☐ Use touch-up paint or alternatively 2K-PUR acrylic paint in the appropriate RAL color to repair large-area surface damage. Observe the relevant instructions of the paint manufacturer.

☐ Use zinc plating with thick-layer passivation to repair damage on the zinc-plated steel frame in the base area, e.g. LZ-09. Observe the relevant instructions of the manufacturer.

Position	RAL color	Color
Roof	RAL 7004	Signal gray

Position	RAL color	Color
Base	RAL 7004	Signal gray
Enclosure	RAL 9016	Traffic white

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7.6, page 104).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

Procedure:

1. Remove dirt.
2. Check surfaces for damage or corrosion.

   If the surfaces are damaged or corroded, repair them without delay or within three weeks at the latest.
3. To remove small-area surface damage:
   - Sand the surface.
   - Clean the surface with degreaser.
   - Paint the surface.
4. To remove large-area surface damage:
   - Sand the surface.
   - Clean the surface with degreaser.
   - Paint the entire surface.

10.5 Maintenance Work on the Inverter

10.5.1 Analyzing the Temperature Indicators

Depending on the type of inverter bridge, the inverter cabinet contains 8 or 17 temperature indicators which monitor the temperature of the inverter bridges.

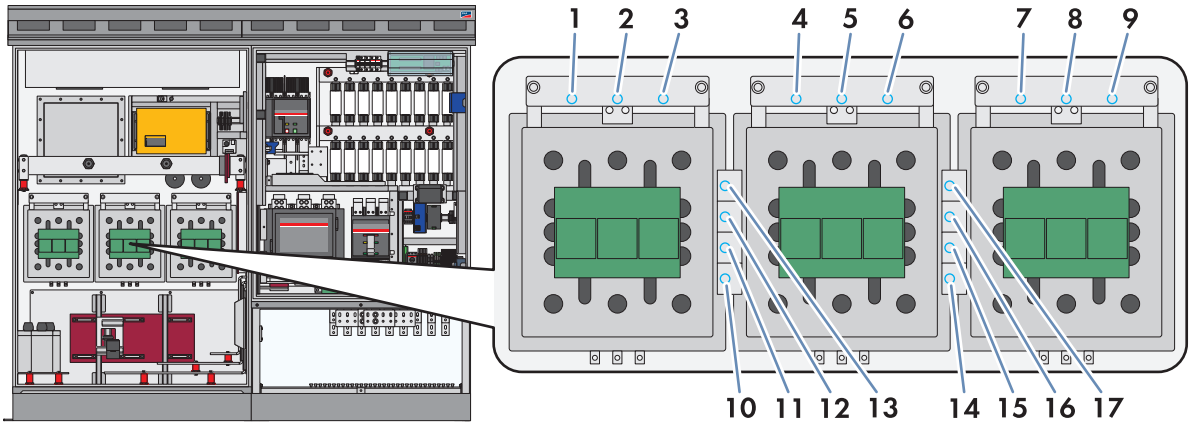


Figure 43: Position of the temperature indicators (example: inverter bridges with connection terminals at the upper end)

Position of the indicators	Type of inverter bridges	Number of indicators
1 to 17	with connection terminals at the upper end	17
10 to 17	without connection terminals at the upper end	8

If the temperature exceeds a value indicated on one of the indicator fields, that field will turn black.

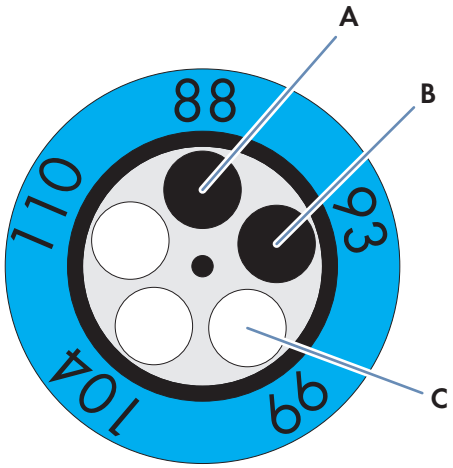


Figure 44: Values on an indicator (example)

Position	Description
A	The indicator field for 88 °C has turned black. The temperature has reached 88 °C.
B	The indicator field for 93 °C has turned black. The temperature has reached 93 °C. The value 93 must be entered in the protocol.
C	The indicator field for 99 °C is white. The temperature has not exceeded 99 °C.

Each time maintenance work is performed, the values of the temperature indicators must be read off and logged. The highest value of the indicators that turned black must be entered in the maintenance report. The interactive protocol "Temperature Indicators Analysis Protocol" can be downloaded at www.SMA-Solar.com.

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

- Switch off the inverter and wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Disconnect the inverter (see Section 7, page 98).

⚠ CAUTION

Risk of burns due to hot components

Some components of the product can get very hot during operation. Touching these components can cause burns.

- Observe the warnings on all components.
- During operation, do not touch any components marked with such warnings.
- After switching off the product, wait until any hot components have cooled down sufficiently.
- Wear suitable personal protective equipment for all work on the product.

Requirement:

☐ The inverter must have been operated under full load for at least six hours before analyzing the values.

Procedure:

1. Ensure that the inverter is disconnected from all voltage sources.
2. Open the inverter cabinet.
3. Read off and log the values of each temperature indicator.
4. Analyze the results and take action if necessary:

Number of the indicator	Value of the indicator	Action
1 to 9	88	There is no need for action.
	93 or higher	Contact the Service (see Section 17 "Contact", page 264).
10 to 17	88 to 99	There is no need for action.
	104 or higher	Contact the Service (see Section 17 "Contact", page 264).

10.5.2 Cleaning the Air Duct and Ventilation Grids

⚠ DANGER

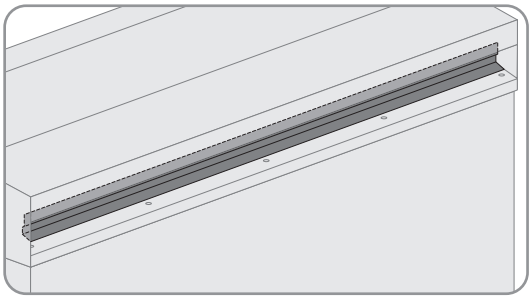
Danger to life due to electric shock or electric arc if live components are touched

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7.6, page 104).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

Procedure:

1. Disassemble the ventilation grids (see Section 12.3.1.3, page 165).
2. Vacuum the air duct from the outside or clean it with a brush.



3. Vacuum the ventilation grids or clean them with a brush.
4. Check the ventilation grids for visible damage. Replace the ventilation grids, if required.
5. Mount the ventilation grids (see Section 12.3.1.3, page 165).

10.5.3 Cleaning the Ventilation Plate

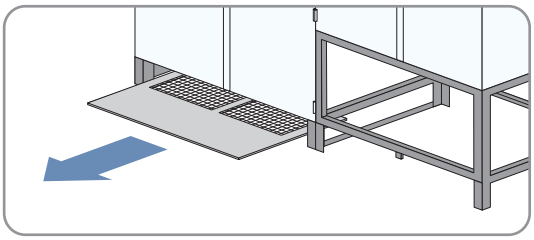
⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

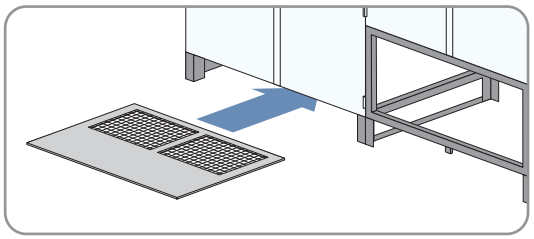
- Switch off the inverter and wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Disconnect the inverter (see Section 7, page 98).

Procedure:

1. Disassemble the panels (see Section 12.3.1.2, page 164).
2. Disassemble the exhaust duct under the inverter.
3. Pull the ventilation plate out of the inverter cabinet. Grip underneath the ventilation plate and press the middle part up while pulling it out.



4. Clean the ventilation plate with a brush or vacuum.
5. Slide the ventilation plate into the inverter cabinet. The ventilation grid in the ventilation plate must face the rear panel.



☑ The ventilation grid ends up flush with the inverter.

✖ The ventilation plate will not go all the way in?

- Grip the ventilation plate from underneath and press the middle part upwards while sliding it in.

6. Mount the exhaust duct under the inverter (see Section 5.3.2, page 54).
7. Mount the panels (see Section 12.3.1.2, page 164).

10.5.4 Checking the Fuses/Disconnection Blades

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7.6, page 104).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

Procedure:

1. Check the fuses/disconnection blades and tension springs for any discoloration or change in appearance.
   If they are discolored or changed in any way, replace them.
2. Check insulation and terminals for any discoloration or change in appearance.
   If insulation and terminals are discolored or changed, contact us (see Section 17 "Contact", page 264).

10.5.5 Checking the Bolted Connections of the Power Cabling

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7.6, page 104).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

NOTICE

Damage to bolted connections through overtightening

If the permitted torques are exceeded, bolted connections can be damaged. In this case, fault-free operation of the inverter is no longer ensured.

- Only tighten loose bolted connections to the prescribed torque. Torque specifications are indicated in the circuit diagram of the inverter. If there is any information missing, contact (see Section 17 "Contact", page 264).

Procedure:

1. Check that the bolted connections of all assemblies are securely in place.
   If bolted connections are loose, tighten them using a torque wrench.
2. Check whether all bolted connections of the power cabling are securely in place.
   If bolted connections are loose, tighten them using a torque wrench.
3. Check the insulation and connections for any discoloration or change in appearance.
   If insulation and connections are discolored or changed, contact us (see Section 17 "Contact", page 264).
4. Check the bolted connections for damage and contact elements for corrosion.
   If bolted connections are damaged or contact elements corroded, replace them.

10.5.6 Checking the Fans

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7.6, page 104).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

Procedure:

1. Switch the inverter to **Stop**.
2. Connect the supply voltage (see Section 7.9.1, page 106).

☑ The fans start to run for a few moments.

✖ The fans do not start up?

- Contact SMA Service Line.

10.5.7 Checking the Labels

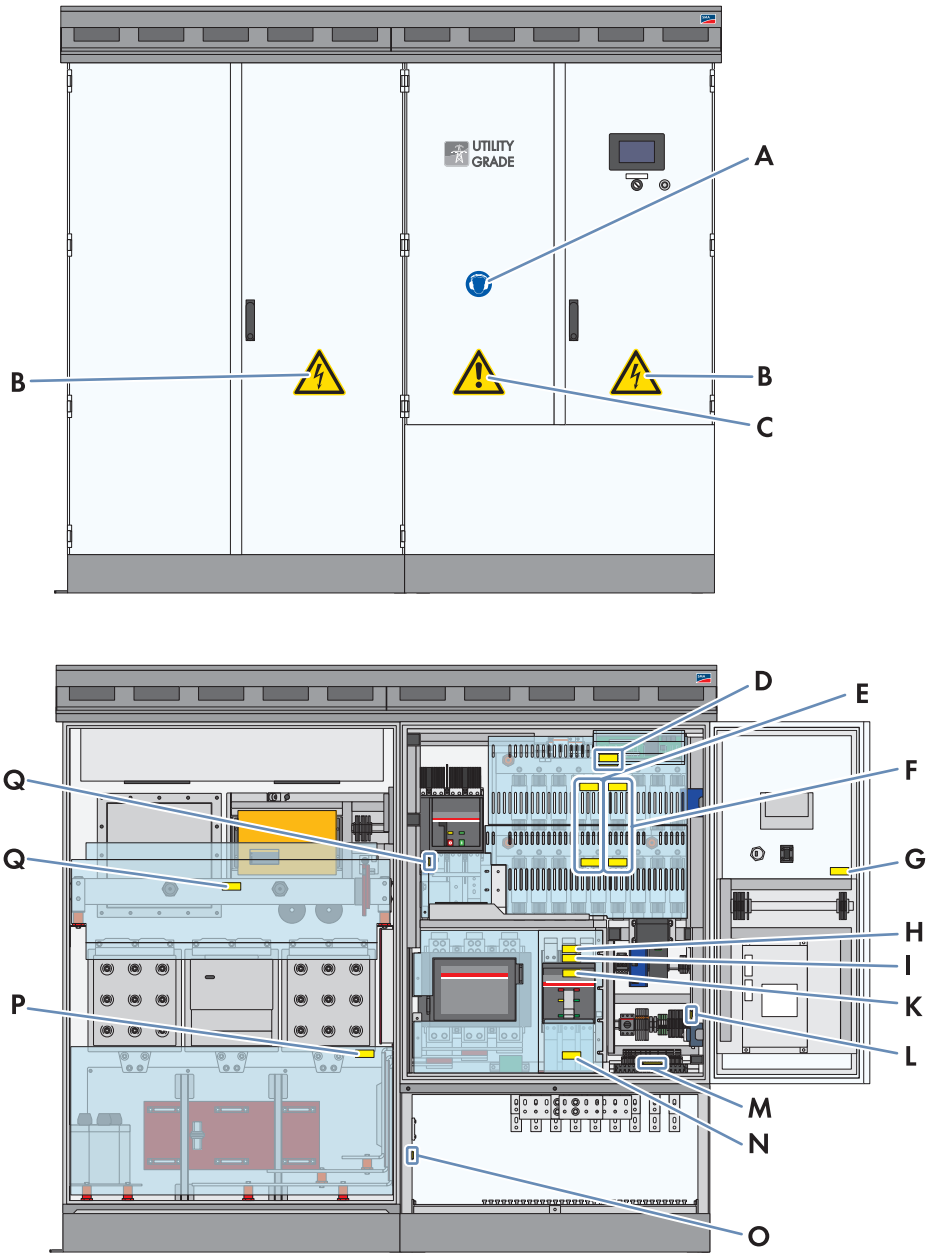


Figure 45: Position of the labels

Position	Order number	Designation
A	86-029687	Use hearing protection
B	86-05200	Beware of dangerous voltage
C	86-79615	Beware of a danger zone
D	86-10867153	Risk of electrical shock even when the device is disconnected.
	86-003307	5 Safety rules
	86-003314	Risk of lethal electric shock due to active power source
E	86-003303	Risk of lethal electric shock due to active power source

Position	Order number	Designation
F	86-1086701025	Danger of burn injury due to hot fuses below the cover.
G	86-0043553	Risk of lethal electric shock due to active power source
H	86-003307	5 Safety rules
I	86-1086701026	The negative pole of the PV generator is grounded in the inverter.
	86-1086701027	The positive pole of the PV generator is grounded in the inverter.
K	86-003304	Unintended tripping due to modified settings.
L	86-003306	Plant protected by conductors.
M	86-003305	Incorrect connection leads to destruction of the device.
N	86-1086701023	Risk of lethal electric shock due to active power source
O	86-0099	Position of grounding
P	86-1086701024	Danger of burn injury due to hot components below the cover.
Q	86-10867153	Risk of electrical shock even when the device is disconnected.

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7.6, page 104).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

Procedure:

- Check whether any warning message or label is damaged or missing.

  Replace any warning messages and labels which are missing or illegible. If necessary, you can order the labels using the order number stated above. Contact us (see Section 17, page 264).

10.5.8 Checking the Heating Elements and Hygrostat

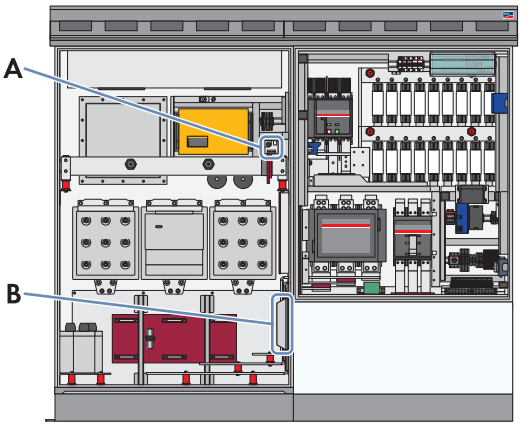


Figure 46: Position of the heating element and the hygrostat

Position	Designation
A	Hygrostat
B	Heating element

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7.6, page 104).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

⚠ CAUTION

Risk of burns due to hot components

Some components of the product can get very hot during operation. Touching these components can cause burns.

- Observe the warnings on all components.
- During operation, do not touch any components marked with such warnings.
- After switching off the product, wait until any hot components have cooled down sufficiently.
- Wear suitable personal protective equipment for all work on the product.

Procedure:

1. Switch the inverter to **Stop** (see Section 7.4.1, page 102).
2. Connect the supply voltage (see Section 7.9.1, page 106).
3. Set the hygrostat to the minimum value. To do this, pull the selector switch out slightly.
   Tip: the hygrostat is adjusted correctly if the relay of the hygrostat emits an audible click.

4. Check whether the heating elements are radiating heat after a delay time of five minutes.
   If the heating elements are not radiating heat, contact us (see Section 17 "Contact", page 264).
5. Reset the hygrostat to the initial value. To do this, press the selector switch back towards the hygrostat. The initial value of the hygrostat is indicated in the circuit diagram.

10.5.9 Checking the Function of the UPS

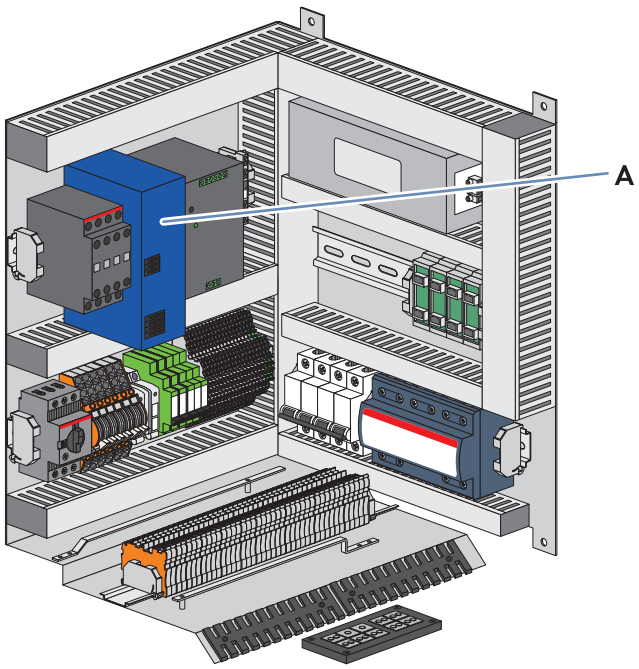


Figure 47: Positon of the UPS

Position	Designation
A	Uninterruptible power supply (UPS)

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

If the MV Power Station and its devices are not correctly disconnected, dangerous voltages may be present in the components which, if touched, will result in death or serious injury.

- Disconnect the MV Power Station (see Section 7.6, page 104).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Ensure that the MV Power Station and its devices are voltage-free.

Procedure:

1. Switch the inverter to **Stop** (see Section 7.4.1, page 102).
2. Connect the supply voltage (see Section 7.9.1, page 106).
3. Measure the voltage at the supply voltage output between L1 and N.
   ☑ The voltage is approximately 230 V.
   ✖ Voltage deviates significantly?
   - Contact SMA Service Line.

4. Measure the voltage at the supply voltage output of the UPS at **-X400** terminal 5 and **-X402** terminal 5.
   ☑ The voltage is approximately 24 V.
   ✖ Voltage deviates significantly?
   - Contact SMA Service Line.
5. Disconnect the supply voltage (see Section 7.4.4, page 103).
6. Measure the time until the communication unit switches off.
   ☑ The communication unit switches off after 15 seconds at the earliest.
   ✖ The communication unit switches off earlier?
   - Contact SMA Service Line.

10.5.10 Checking the AC Disconnection Unit

The inverter is optionally equipped with an AC disconnection unit. If a circuit breaker manufactured by ABB is installed, it needs to be checked. If a circuit breaker by LS Industrial Systems is installed, no checking is necessary.

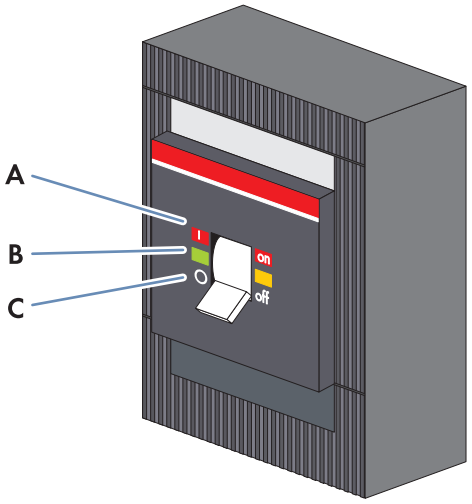


Figure 48: Switch positions of the AC disconnection unit from ABB

Position	Designation	Explanation
A	Switch position **on**	The AC disconnection unit is closed.
B	Central switch position	The AC disconnection unit was tripped and is open.
C	Switch position **off**	The AC disconnection unit is open.

Additionally required maintenance material (not included in the scope of delivery):

☐ Test device approved by the manufacturer of the AC disconnection unit, e.g. TT1 by ABB

⚠ DANGER

Danger to life from electric shock due to live voltage

High voltages are present in the conductive components of the inverter. Touching live components results in death or serious injury due to electric shock.

- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Wear suitable personal protective equipment for all work on the product.
- All work must be carried out in accordance with this document. All safety information must be observed.
- Do not touch any live components of the inverter or the medium-voltage grid. Comply with all applicable safety regulations for handling medium-voltage grids.

Procedure:

1. Use the test device to check whether the AC disconnection unit is ready for operation (instructions for testing are included in the documentation of the testing device).
2. If the AC disconnection unit is not ready for operation, contact (see Section 17 "Contact", page 264).

10.5.11 Checking the DC switchgear

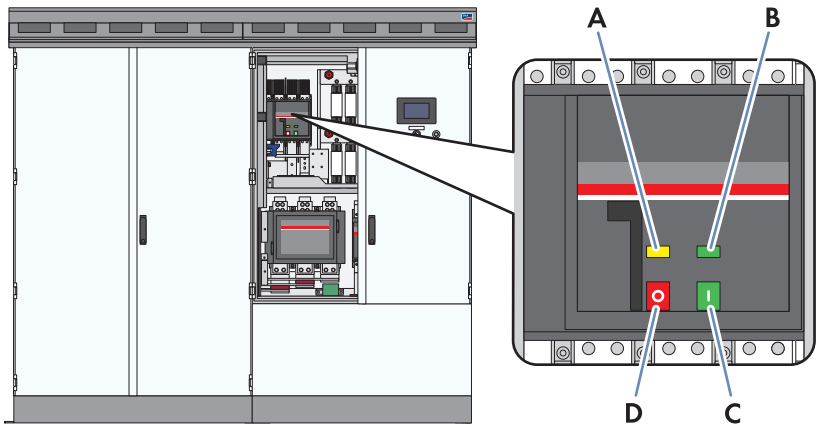


Figure 49: Indicators on the DC load-break switch

Position	Designation
A	Spring status indicator
B	Position indicator
C	ON button
D	OFF button

Requirements:

☐ Supply voltage must be present.

⚠ DANGER

Danger to life from electric shock due to live voltage

High voltages are present in the conductive components of the inverter. Touching live components results in death or serious injury due to electric shock.

- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Wear suitable personal protective equipment for all work on the product.
- All work must be carried out in accordance with this document. All safety information must be observed.
- Do not touch any live components of the inverter or the medium-voltage grid. Comply with all applicable safety regulations for handling medium-voltage grids.

Procedure:

1. Switch the inverter to **Stop** (see Section 7.4.1, page 102).
2. Open the doors of the interface cabinet.
3. Check whether the DC load-break switch is switched off and indicating the **Off** position.

   If the DC load-break switch is not switched off or not indicating the position **Off**, contact (see Section 17 "Contact", page 264).
4. Close the doors of the interface cabinet.
5. Switch the inverter to **Start**.
6. Open the doors of the interface cabinet.
7. Check whether the DC load-break switch is switched on and indicating the position **On**.

   If the DC load-break switch is not switched on or not indicating the position **On**, contact (see Section 17 "Contact", page 264).
8. Switch the inverter to **Stop**.
9. Test the switching process three times.
10. Close the doors of the interface cabinet.

11 Disposal

Proper disposal

A MV Power Station which has come to the end of their service life constitute electronic waste. Electronic waste contains on the one hand valuable materials (e.g. copper, aluminum or steel) which can be recycled as secondary raw materials, and on the other, substances which are hazardous to the environment (e.g. oil or SF6 gas). Contact your local commercial disposal services for information on optimum material utilization and environmentally friendly disposal.

For further information on disposal and recycling, refer to the respective documentation of the individual devices. For example, after the useful life has expired, the SF6 gas used in medium-voltage switchgears can be extracted completely and then sent for recycling.

We can support you (see Section 17, page 264) in implementing the measures necessary for the disposal and recycling of the PV power plants.

12 Periodic Actions

12.1 Opening and Closing the Doors of the Station Container

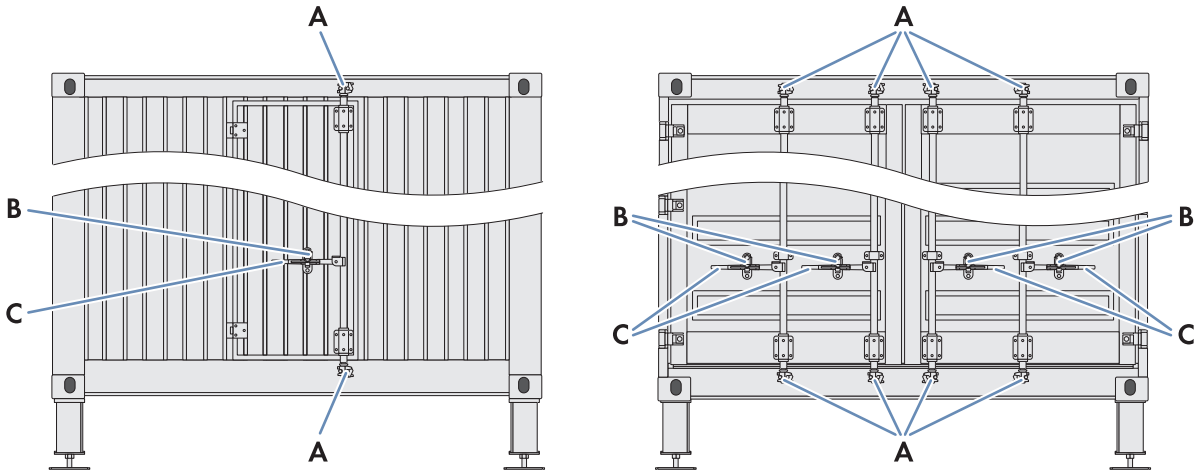


Figure 50: Elements of the station container doors

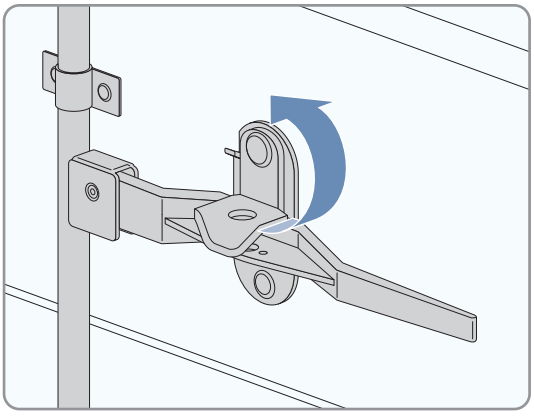
Position	Designation
A	Locking mechanism
B	Sealing mechanism
C	Door handle

Unlocking the doors of the station container

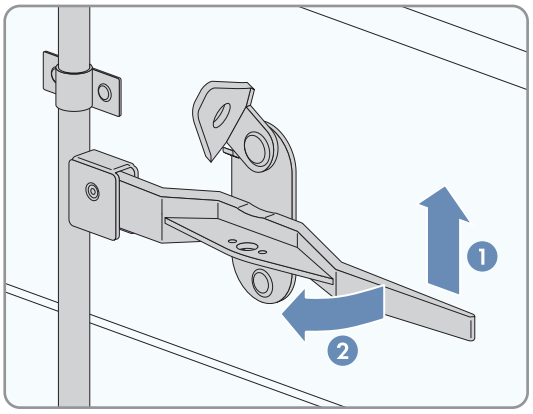
To access the medium-voltage switchgear and the Communit or the rear sides of the inverter or to perform maintenance work, you must unlock and open the doors of the station container.

Procedure:

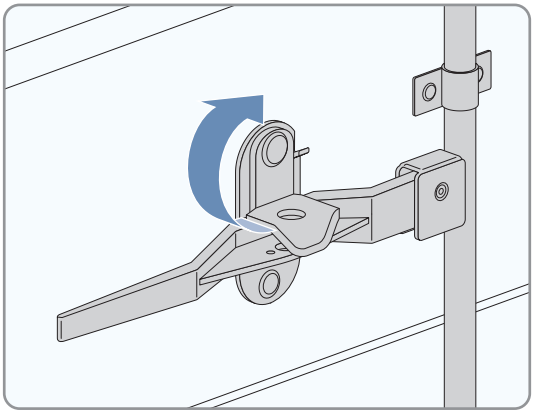
1. Release the two sealing mechanisms on the right-hand door handle. Turn the sealing mechanisms counterclockwise.



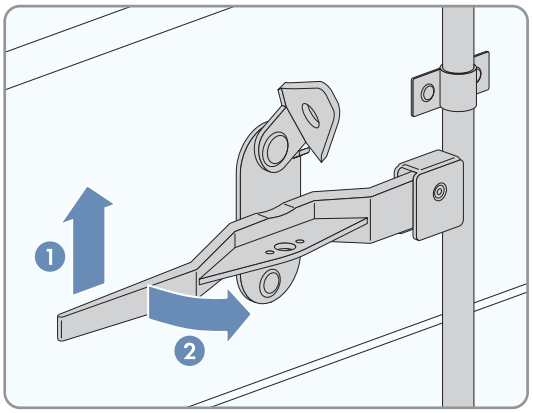
2. Pull the right-hand door handle up and out.



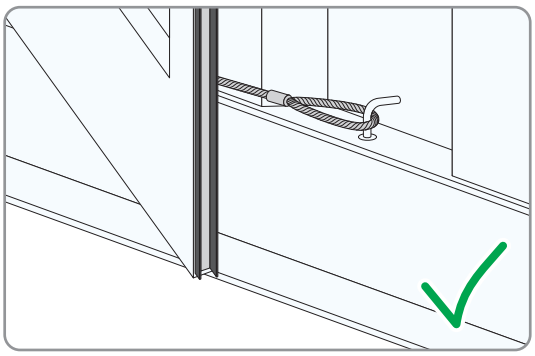
3. Release the two sealing mechanisms on the left-hand door handle. Turn the sealing mechanisms clockwise.



4. Pull the left-hand door handle up and out.

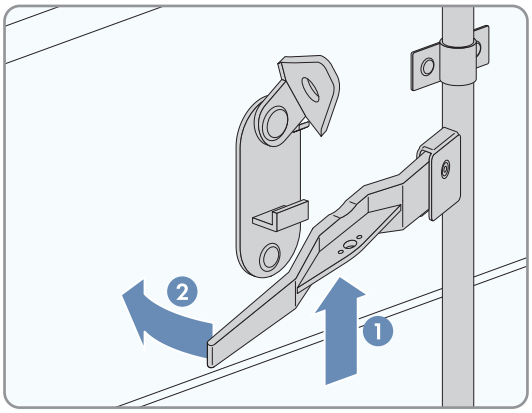


5. Open the doors and make sure they cannot be closed.

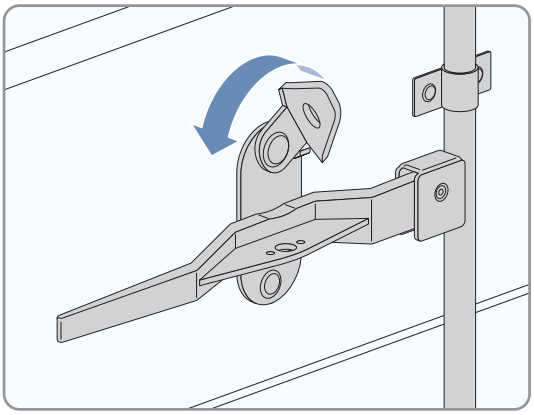


Locking the doors of the station container

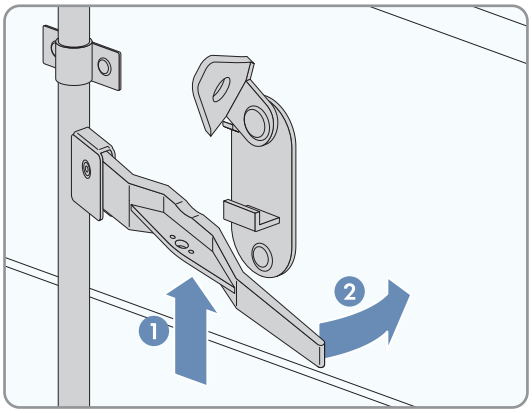
1. Release and close the doors.
2. Press the left-hand door handle in towards the door and press down.



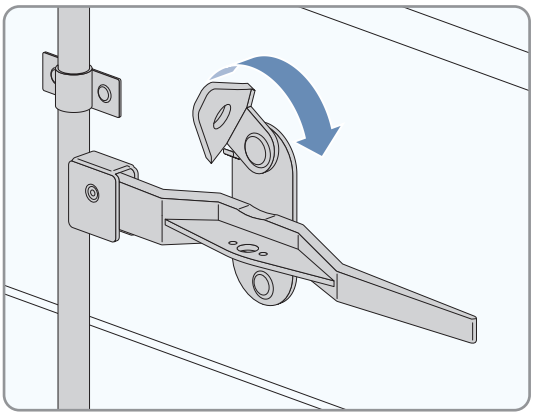
3. Lock the two sealing mechanisms on the left-hand door handle. Turn the sealing mechanisms counterclockwise.



4. Push the right-hand door handle in towards the door and press down.



5. Lock the two sealing mechanisms on the right-hand door handle. Turn the sealing mechanisms clockwise.



6. Make sure that the locking mechanisms are correctly engaged at the top and bottom.

12.2 Setting up the Service Platform at the Medium-Voltage Switchgear Compartment

For all work in the medium-voltage switchgear compartment, the service platform must be mounted in front of the medium-voltage switchgear compartment.

⚠ CAUTION

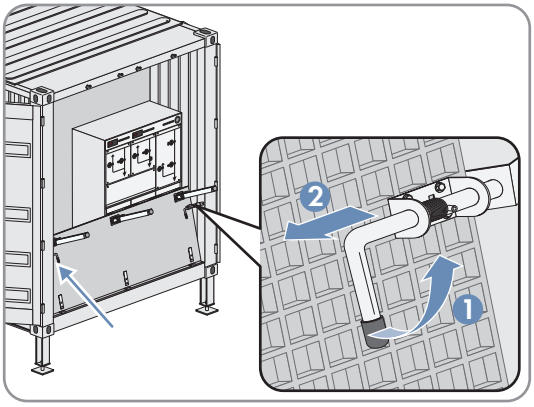
Risk of injury if heavy service platforms are lowered too fast

The service platforms of the MV Power Station are very heavy. If service platforms are folded down too fast or dropped, persons could be injured.

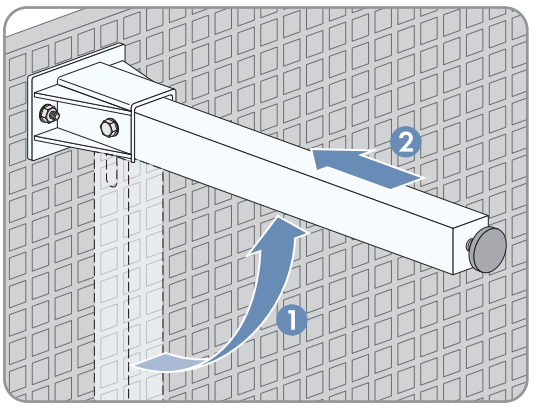
- Have at least two people pull each service platform forwards and down.
- Always wear suitable protective equipment.

Procedure:

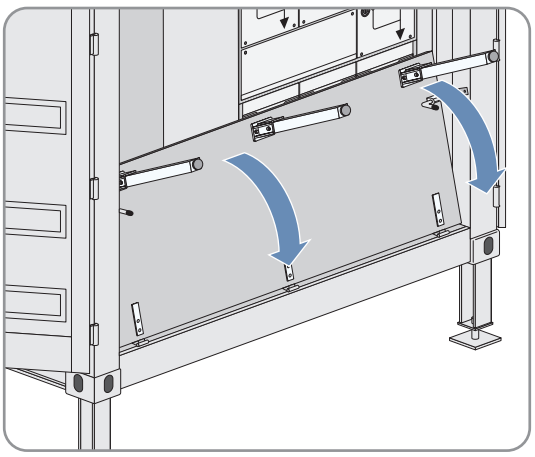
1. Open the doors of the medium-voltage switchgear compartment (see Section 12.1, page 159).
2. Unlock the service platform.



3. Flip up and lock the support feet of the service platform.



4. Flip down the service platform. Have at least two persons holding the support feet. This will prevent the support feet in the locking device from loosening.



12.3 Mounting and Disassembly Work

12.3.1 Mounting and Disassembly Work in the Inverter

12.3.1.1 Disassembling and Mounting the Protective Covers

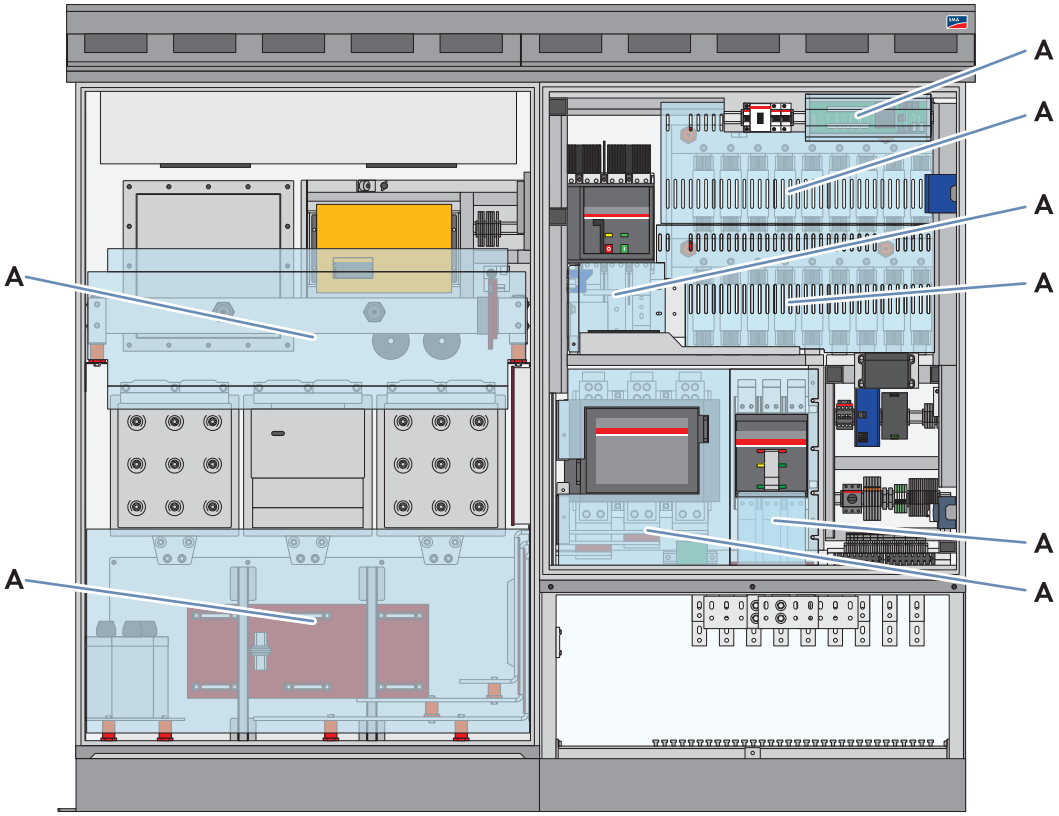


Figure 51: Position of the protective covers

Position	Designation
A	Protective cover

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

- Switch off the inverter and wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Disconnect the inverter (see Section 7, page 98).

Disassembling the protective covers

Requirements:

☐ The panels must be disassembled (see Section 12.3.1.2, page 164).

Procedure:

- Disassemble the protective covers.

Mounting the protective covers

1. Tighten all protective covers (torque: 5 Nm).
2. Ensure that the protective covers are firmly in place.

12.3.1.2 Disassembling and Mounting the Panels

⚠ DANGER

Danger to life due to electric shock or electric arc if live components are touched

- Switch off the inverter and wait at least 15 minutes before opening it to allow the capacitors to discharge completely.
- Disconnect the inverter (see Section 7, page 98).

NOTICE

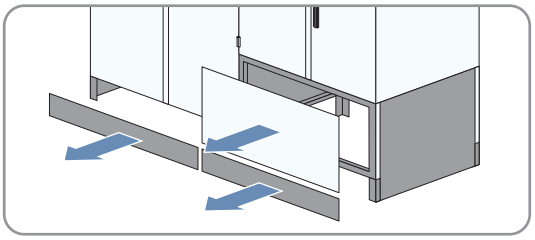
Property damage due to rupture of grounding conductors

The components are connected to the inverter via the grounding conductor. If the roof is not disassembled correctly, the grounding conductors may be pulled out.

- Take care not to damage the grounding conductors during disassembly.

Disassembling the panels

1. Remove the screws of the front panels using a Torx screwdriver (head size T30).
2. Detach the grounding straps from the panels.
3. Remove the panels.



Mounting the panels

Requirement:

☐ The protective covers in the connection area must be mounted (see Section 12.3.1.1, page 163).

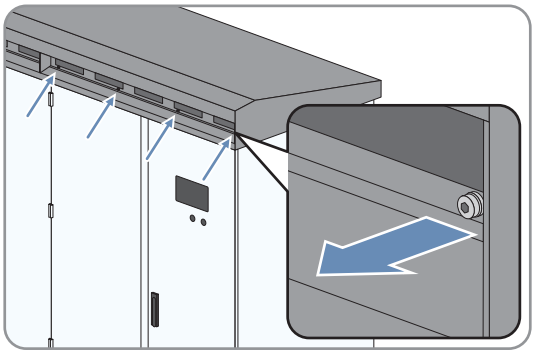
Procedure:

1. Attach the grounding straps to the panels of the interface cabinet (torque: 8 Nm to 10 Nm).
2. Ensure that the grounding straps are firmly in place.
3. Attach the panels using a Torx screwdriver (torque: 2 Nm to 3 Nm, head size T30).

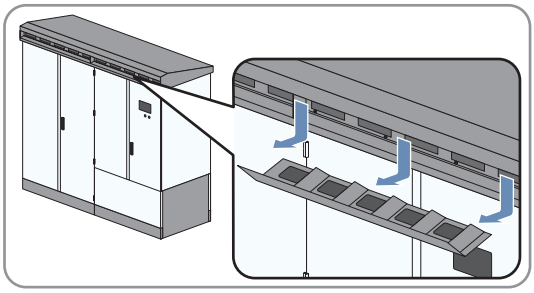
12.3.1.3 Disassembling and Mounting the Ventilation Grids

Disassembling the ventilation grids

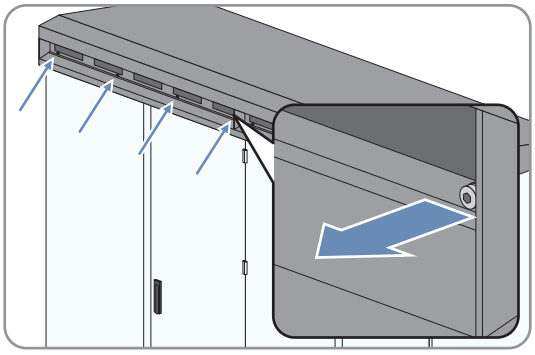
1. Release the screws of the right-hand ventilation grid. (head size:-T40).



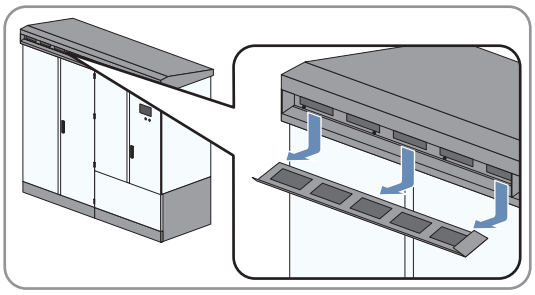
2. Pull the lower side of the right-hand ventilation grid forwards to remove it.



3. Release the screws of the left-hand ventilation grid. (head size:-T40).

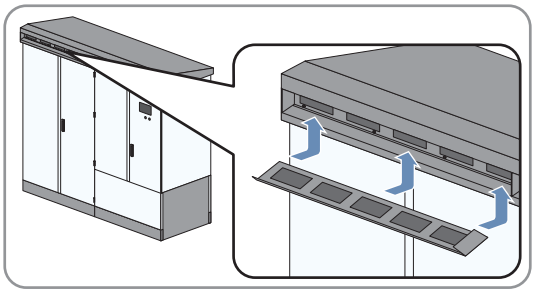


4. Pull the lower side of the left-hand ventilation grid forwards to remove it.

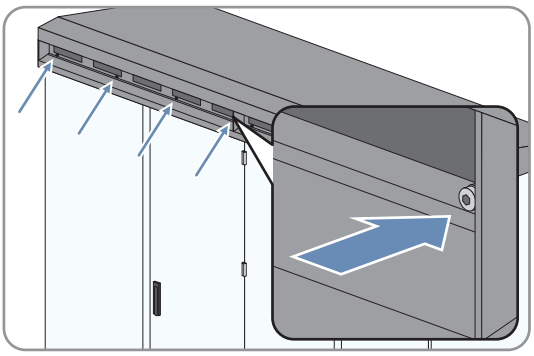


Mounting the ventilation grids

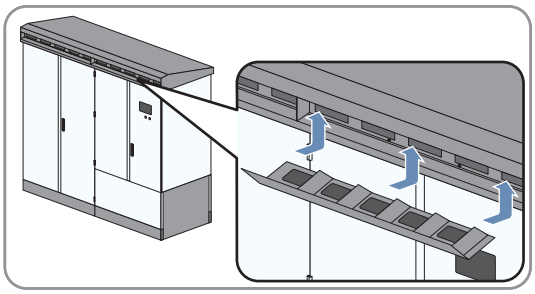
1. Insert the left-hand ventilation grid.



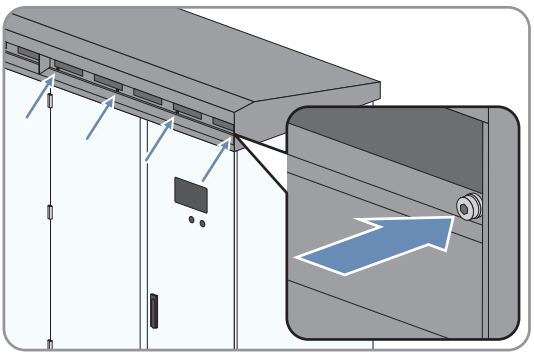
2. Screw the left-hand ventilation grid on (torque: 20 Nm,-head size T40).



3. Insert the right-hand ventilation grid.



4. Screw the right-hand ventilation grid on (torque: 20 Nm,-head size T40).



12.3.2 Mounting and Disassembly Work in the Medium-Voltage Switchgear

12.3.2.1 Disassembling and Mounting the Kick Plates

Disassembling the kick plate

1. Loosen all screws of the kick plate.
2. Carefully pull the kick plate forwards by 80 mm to 100 mm.
3. Loosen the grounding strap from the kick plate.
4. Remove the kick plate.

Mounting the kick plate

1. Position the kick plate.
2. Tighten the grounding strap on the panel (torque: 14 Nm).
3. Check that the grounding strap is securely attached.
4. Attach the kick plate with the previously removed screws.

12.4 Cable Entry

12.4.1 Inserting the Cables through the Base Plates

12.4.1.1 Overview of the Base Plates on the MV Power Station

The MV Power Station is fitted with base plates through which the cables are inserted. The cables should be protected between the foundation and the MV Power Station. Cable protection measures are customer responsibility.

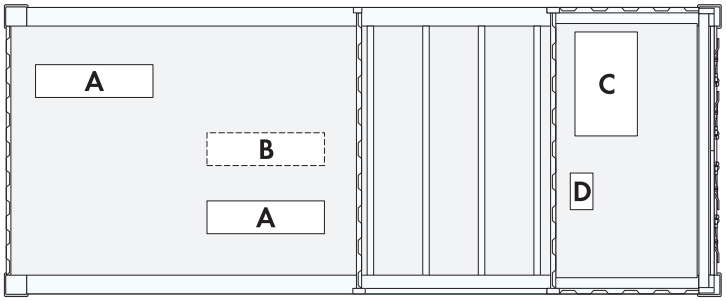


Figure 52: Position of the base plates and openings for cables

Position	Designation
A	Base plate of the Sunny Central in the MV Power Station 1000-2SC/1250SC/1600SC/1800SC/2000SC
B	Base plate of the Sunny Central in the MV Power Station 500SC/630SC/800SC/900SC/1000-1SC
C	Base plate of the medium-voltage switchgear: • 6 openings for single-core cables; maximum cable diameter: 55 mm
D	Base plate with cable glands for the data cables and grounding cables: • 3 x PG9 for cable diameters from 6 mm to 8 mm • 3 x PG11 for cable diameters from 8 mm to 10.5 mm • 4 x PG16 for cable diameters from 13 mm to 16 mm • 4 x PG21 for cable diameters from 17 mm to 20 mm

12.4.1.2 Inserting Cables through the Base Plates of the Inverters

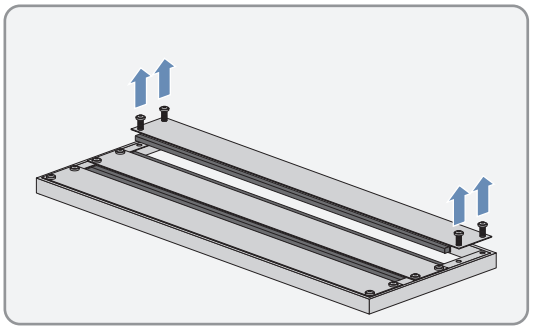
Requirement:

☐ The service platform in front of the inverter compartment must be installed.

Procedure:

1. Open the inverter compartment (see Section 12.1, page 159).
2. Cut the cables to the required length. Allow for some reserve.

3. Unscrew and remove all parts of the base plate underneath the connection area of the inverter. This will give you enough room for inserting the cables.



4. Lead all cables for the connection in the inverter through the opening. Make sure that the data cables are routed separately from the power cables.
5. Connect the cables and remount all parts of the base plate (see Section 5.8.1, page 72).

12.4.1.3 Inserting the Cables through the Base Plates of the Medium-Voltage Switchgear

Requirements:

☐ The doors of the medium-voltage compartment must be open (see Section 12.1, page 159).

☐ The service platform in front of the medium-voltage compartment must be installed (see Section 12.2, page 162).

Cable requirement:

☐ Maximum cable diameter: 55 mm

Procedure:

1. Cut the cables to the required length. Allow for some reserve.
2. Disassemble the kick plate of the medium-voltage switchgear.
3. If protective tubes are used, carry out the following steps:
   - Disassemble the base plate underneath the medium-voltage switchgear.
   - Route protective tubes up to the base plates. Allow for some reserve.
   - Close the protective tubes, e.g. with expanding foam.
   - Mount the base plate.
4. Remove the cable support sleeves from the base plate.
5. Cut off the ends of the cable support sleeves. Observe the number and the diameter of the cables to guarantee tightness.
6. Insert the cables in the base plate. Make sure that the cable support sleeves entirely close the openings.
7. Insert the cables through the cable support sleeves in the medium-voltage switchgear.
8. Mount the kick plates of the medium-voltage switchgear.

12.4.1.4 Inserting the Cables through the Cable Glands

The grounding cables and data cables for the Communit must be inserted through the cable glands in the medium-voltage switchgear compartment.

Cable requirements:

☐ Cable diameter for the grounding cables: 7 mm to 17 mm

☐ Cable diameter for the data cables: 4 mm to 9 mm

Requirements:

☐ The doors of the medium-voltage compartment must be open (see Section 12.1, page 159).

☐ The service platform in front of the medium-voltage compartment must be installed (see Section 12.2, page 162).

Procedure:

1. Remove the base plate with the cable glands. This will give you enough room for inserting the cables.
2. Lead the cables through the opening.
3. Lead each cable through one cable gland as follows:
   - Unscrew the swivel nut of the cable gland.
   - Remove the sealing plug from the cable gland.
   - Lead the cable through the cable gland. Allow sufficient cable length to reach the connection point.
   - Lead the cable through the swivel nut of the cable gland. Ensure that the thread of the swivel nut is facing downwards.

12.4.2 Inserting the Cables in the Communit

The cables for the connection of the communication devices are inserted through the cable gland in the floor of the Communit.

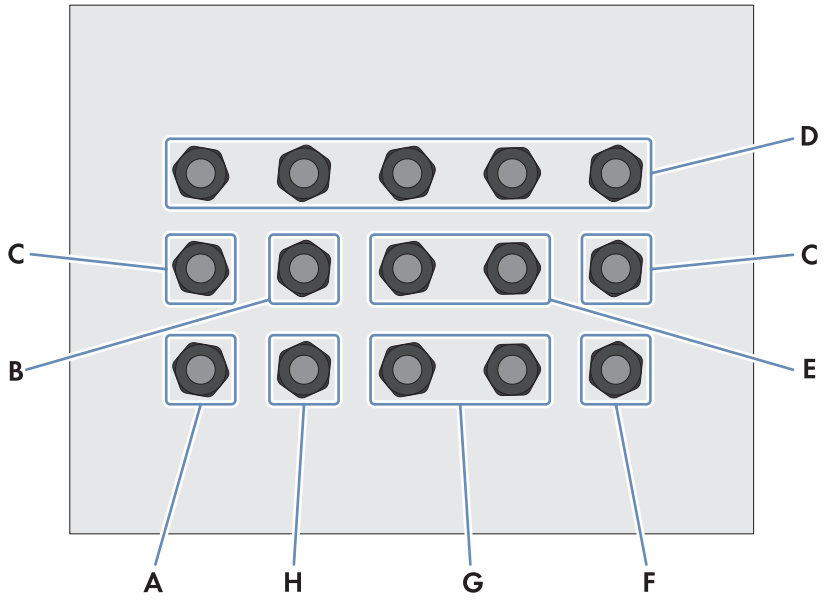


Figure 53: Cable glands in the floor of the Communit

Position	Recommendations for cable insertion
A	For the supply voltage cable
B	For the Sunny SensorBox cable
C	For optical fibers
D	Reserve
E	For the RS485 cable
F	For the antenna cable
G	For the network cables
H	For the RS485 cable

Unused cable glands

Do not remove the filler plugs of the unused cable glands. The filler plugs serve as seals for the product.

NOTICE

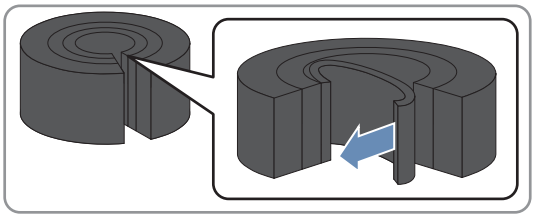
Property damage due to dust intrusion and moisture penetration

Dust or moisture intrusion can damage the product and impair its functionality.

- Only remove the number of sealing rings from the rubber seal in the cable gland that corresponds to the cable diameter.

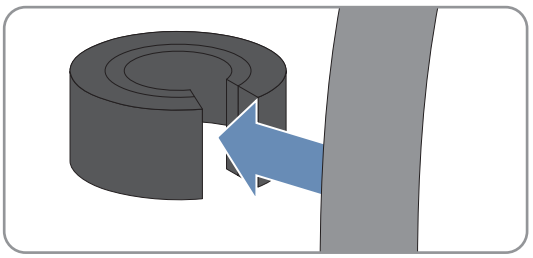
Procedure:

1. Open the door of the Communit and, if necessary, remove it completely.
2. Remove the rubber seal from the cable gland.
3. Adjust the rubber seal to the diameter of the cable to be inserted. Remove the appropriate number of sealing rings from the rubber seal.

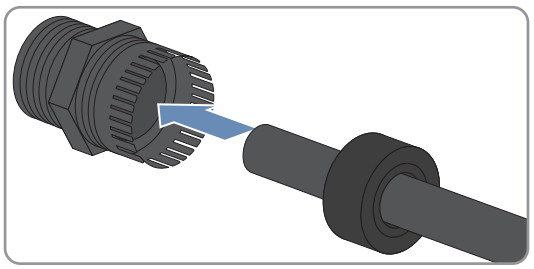


Cable diameter	Number of sealing rings to be removed
4.5 mm to 5.0 mm	0
4.5 mm to 7.5 mm	1
7.0 mm to 10.0 mm	2
9.5 mm to 13.0 mm	3

4. Lead the cable through the swivel nut of the cable gland. Ensure that the thread of the swivel nut is facing upwards.
5. Insert the cable above the swivel nut sideways into the rubber seal.



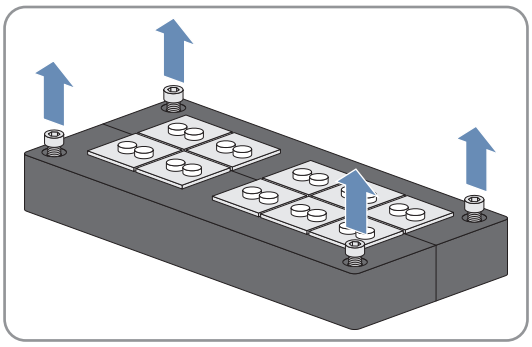
6. Insert the rubber seal with the cable in the cable gland.



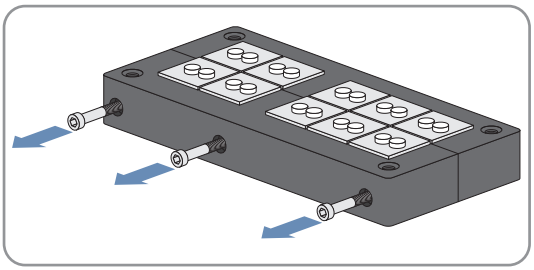
7. Tighten the cable gland.

12.4.3 Inserting the Cables

1. Remove the screws at the top of the sealing plate.



2. Remove the sealing plate.
3. Loosen the screws at the side of the sealing plate.



4. Remove the required number of rubber seals from the sealing plate. Make sure that the diameter of the rubber seals corresponds to the diameter of the cables to be inserted. Use the additional rubber seals included in the scope of delivery, if necessary.
5. Remove the sealing plugs from those rubber seals through which the cables are to be led.
6. Lead the cables through the rubber seals.
7. Insert the rubber seals in the sealing plate avoiding any distortion. This will ensure the tightness of the seal.
8. Tighten the screws at the side of the sealing plate.
9. Screw the sealing plate to the floor of the interface cabinet.

12.5 Bolted Connections

12.5.1 Preparing the Grounding and DC Cables for Connection

Connection overview with one two-hole terminal lug for grounding and DC cables

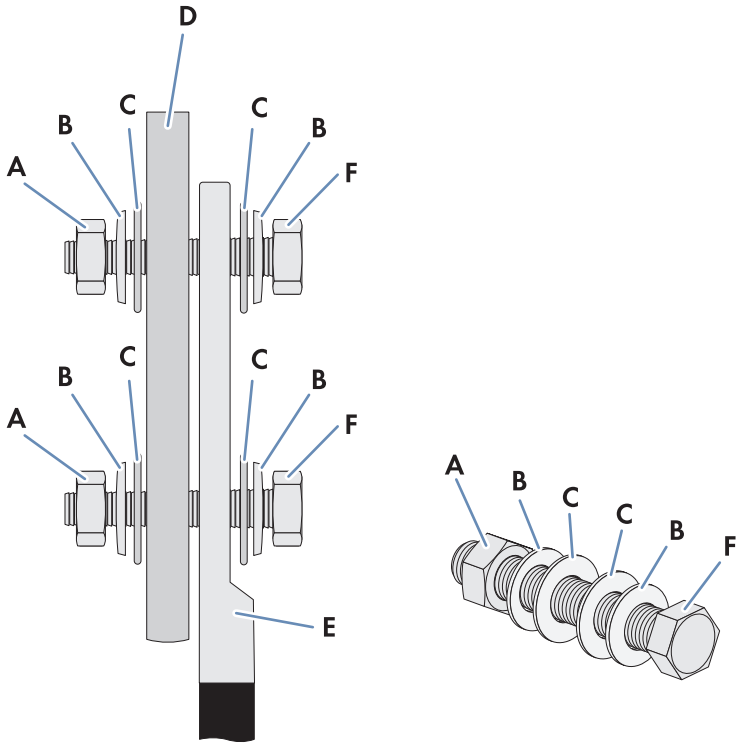


Figure 54: Design of the connection with one two-hole terminal lug

Position	Designation
A	Nut M12
B	Spring washer
C	Fender washer
D	Connection busbar
E	Tin-plated two-hole terminal lug
F	Screw M12

Connection overview with one one-hole terminal lug for grounding and DC cables

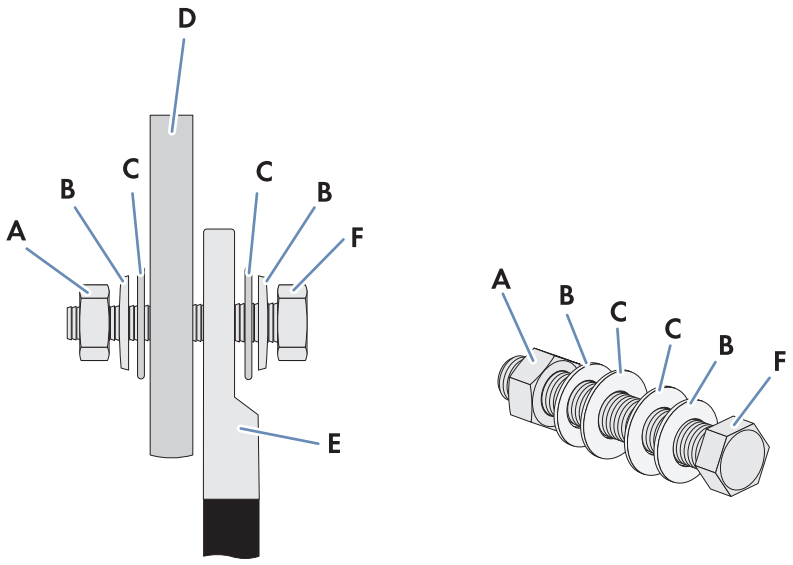


Figure 55: Design of the connection with one one-hole terminal lug

Position	Designation
A	Nut M12
B	Spring washer
C	Fender washer
D	Connection busbar
E	Tin-plated one-hole terminal lug
F	Screw M12

Connection overview with two two-hole terminal lugs for DC cables

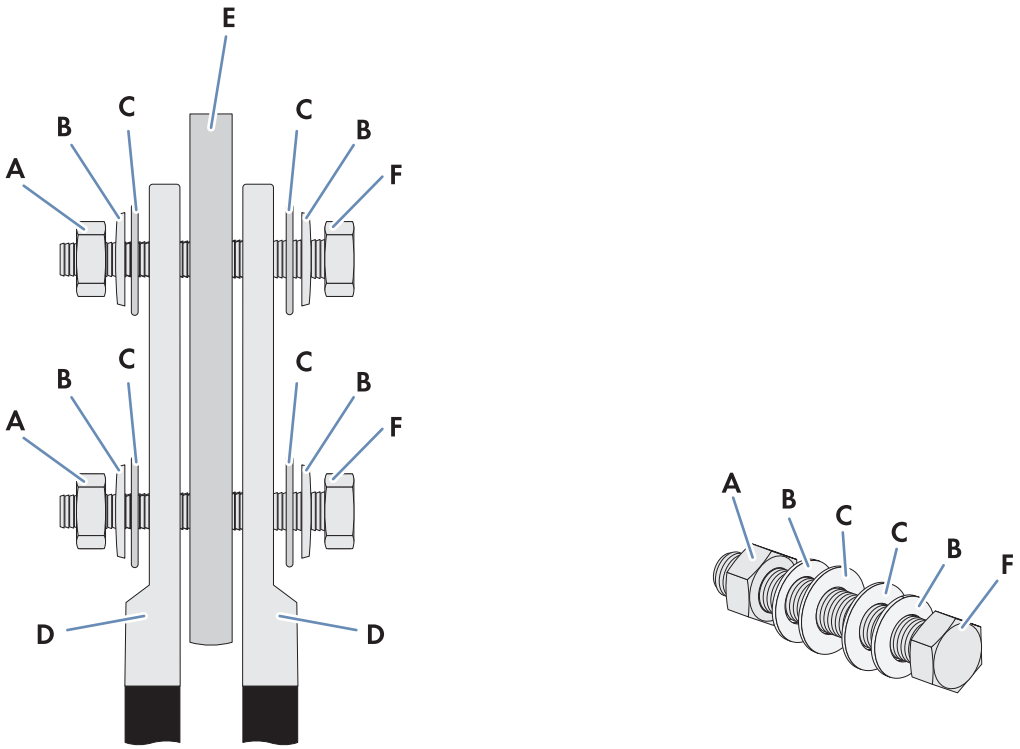


Figure 56: Design of the connection with two two-hole terminal lugs

Position	Designation
A	Nut M12
B	Spring washer
C	Fender washer
D	Tin-plated two-hole terminal lugs
E	Connection busbar
F	Screw M12

Connection overview with two one-hole terminal lugs for DC cables

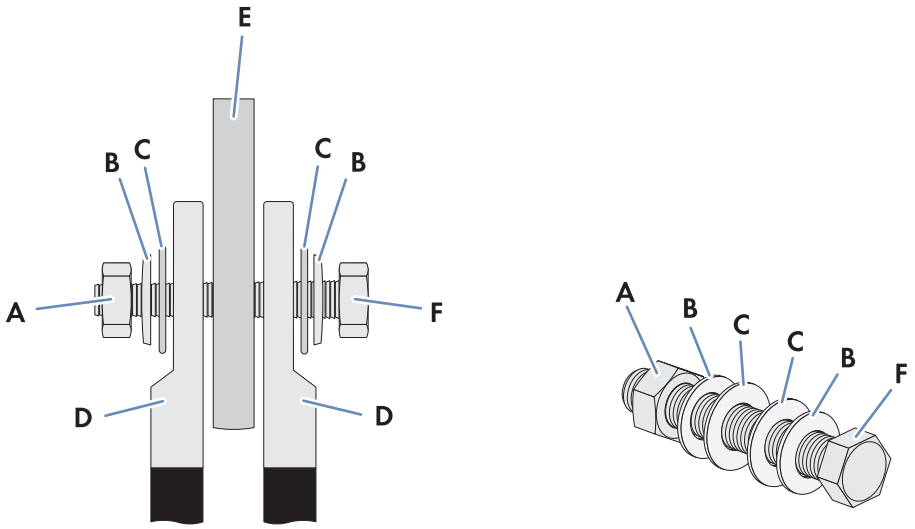


Figure 57: Design of the connection with two one-hole terminal lugs

Position	Designation
A	Nut M12
B	Spring washer
C	Fender washer
D	Tin-plated one-hole terminal lugs
E	Connection busbar
F	Screw M12

Additionally required mounting material (not included in the scope of delivery):

☐ Clean cloth

☐ Ethanol cleaning agent

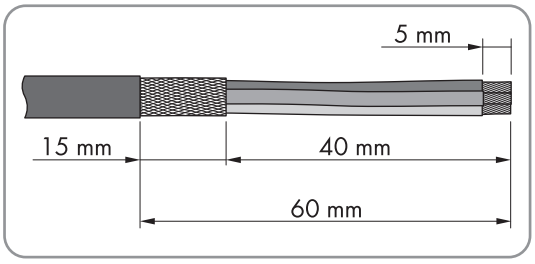
Procedure:

1. Strip the cable insulation.
2. Fit the cables with terminal lugs.
3. Clean the contact surfaces of the terminal lugs with a clean cloth and ethanol cleaning agent.

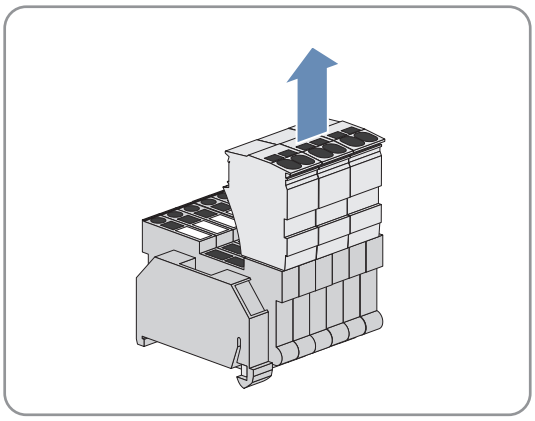
12.6 Clamp Connections

12.6.1 Connecting the Cable to the Spring-Cage Terminals

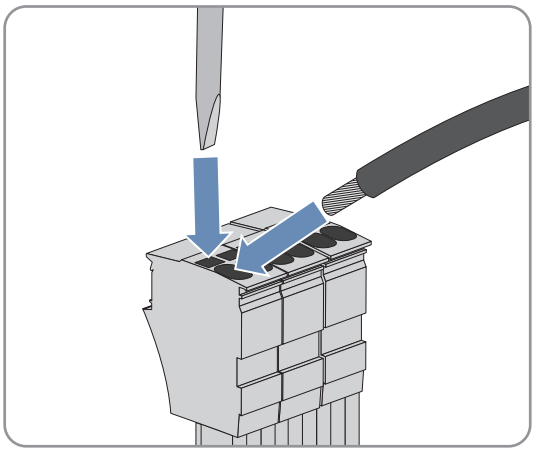
1. Dismantle the cable.



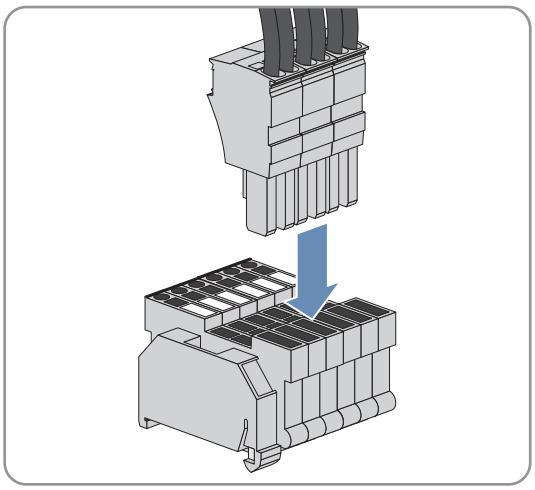
2. Strip the insulation of the insulated conductors.
3. Connect the cable in accordance with the circuit diagram.
   - Remove the connection plug from the base terminal.



   - Insert the screwdriver in the square opening of the connection plug. This will release the opening of the connection plug for the insulated conductors.

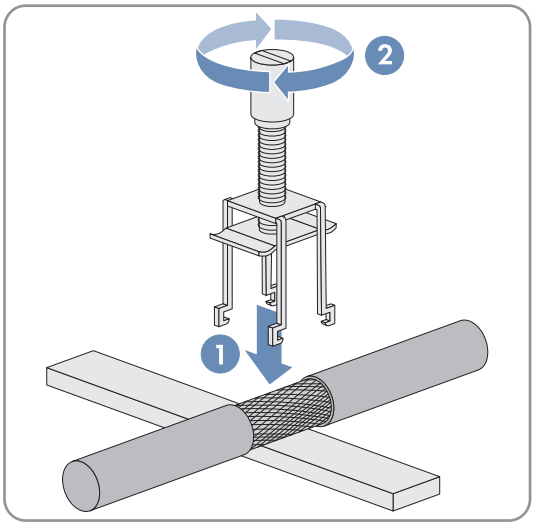


   - Insert the insulated conductors of the cable into the connection plug in accordance with the circuit diagram.
   - Remove the screwdriver from the connection plug.
   - Plug the connection plug into the base terminal.



12.6.2 Connecting the Cable Shield Using a Shield Clamping Saddle

1. Remove the shield clamping saddle from the busbar.
2. Press the shield clamping saddle down onto the shield of the stripped cable until it snaps into place and fasten hand-tight.



12.7 Entering the Password via the Touch Display

Installer access

The "Installer" access level is activated by entering the installer password. The access level is reset after 15 minutes.

Procedure:

1. Select .
2. Select .
3. Confirm your entry by selecting .

☑ The symbol appears in the status info line.

12.8 Settings on the User Interface of the Inverter

12.8.1 Logging Into the User Interface

Default network settings for the service interface

IP address: 192.168.100.2

Subnet mask: 255.255.255.0

Password for the user groups "installer" and "user": sma

Identical passwords for the user groups

If your "user" password is the same as your "installer" password, you will automatically be logged in as an installer.

Requirement:

☐ JavaScript must be enabled in your web browser (e.g. Internet Explorer).

Procedure:

1. Connect the laptop to the service interface of the inverter.
2. Start your web browser.

3. Enter the IP address of the communication unit in the address bar and press the enter key.
   ☑ The user interface opens.
4. To change the language, select the desired language in the field **Language**.
5. Enter the password in the field **Password**.
6. Select the button [**Login**].

12.8.2 Logging Out of the User Interface

Always log out from the user interface when you have finished your work. If you only close the web browser, you will not be logged out. If the user interface is left idle for 15 minutes, you will be logged out automatically.

Procedure:

- Select the button [**Logout**].

12.8.3 Accessing the Parameter Overview

1. Log into the user interface as an installer.
2. Select **Data > Devices**.
3. Select the desired device from the list.
4. Select the tab **Parameters**.

12.8.4 Saving Parameter Changes

Requirement:

☐ You must be logged in on the user interface.

Procedure:

1. Change the respective parameter via the field **Value**.
2. To adopt this value for all devices of the same type and with the same firmware version, activate the box **Save for all devices of this device type**.
3. Select the button [**Save**].
   ☑ The communication unit adjusts the required value on the device(s).
4. Select the button [**OK**].

13 Function Description

13.1 Operating States

13.1.1 Overview of the Operating States

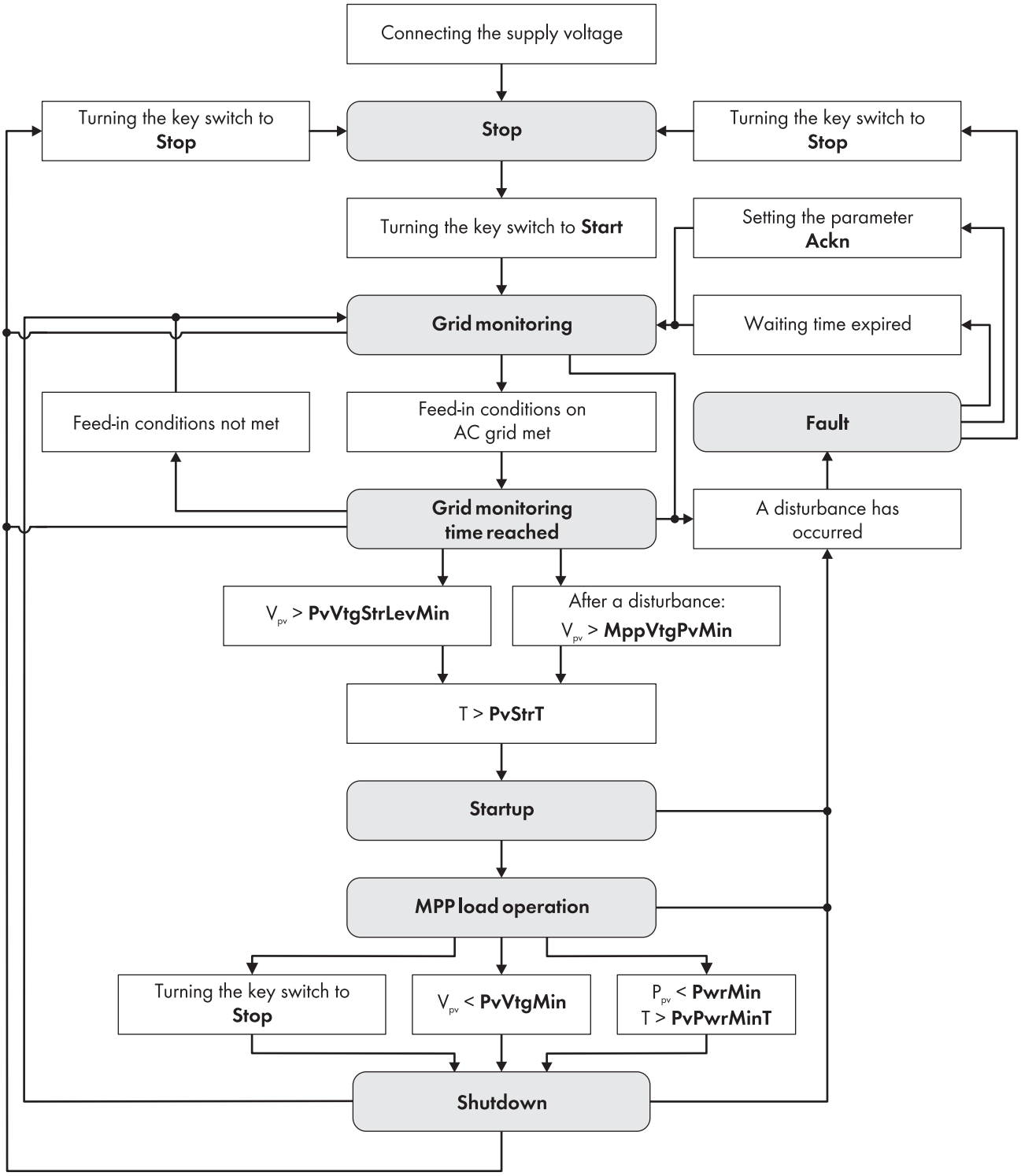


Figure 58: General overview of the operating states of the inverter

13.1.2 Stop

The inverter is switched off. **Stop**, **Fast stop** or **Remote shutdown active** will appear on the touch display. If the key switch is set to **Start**, the inverter switches to the operating state "Grid monitoring".

13.1.3 Grid Monitoring

13.1.3.1 Monitoring the Grid Voltage

In the operating state "Grid monitoring", **Waiting for valid AC grid** appears on the touch display. The grid limits are monitored continuously from now on. If no grid error occurs during the grid monitoring time, the AC contactor closes and the inverter switches to the operating state "Grid monitoring time reached". If the grid limits are exceeded during the monitoring time, the inverter will restart "Grid monitoring".

You can specify the thresholds and the delay time manually. For voltage monitoring, you can set two limits for overvoltage and two limits for undervoltage. If the grid voltage increases above the value defined in the parameter **VCtlhhLim** or **VCtlhLim**, the inverter waits for the time defined in the parameter **VCtlhhLimTm** or **VCtlhLimTm** and disconnects from the utility grid.

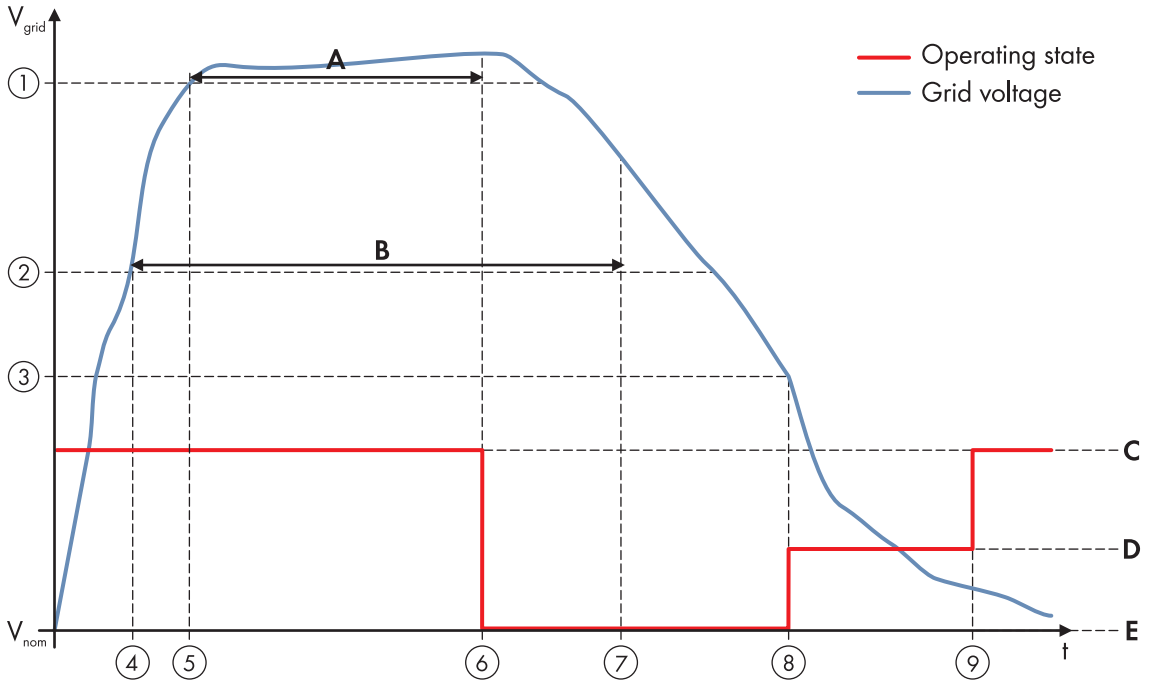


Figure 59: Temporal inverter behavior when the grid limits are exceeded

Position	Parameter	Description
A	VCtlhhLimTm	Delay time for grid limit level 2
B	VCtlhLimTm	Delay time for grid limit level 1
C	–	Startup/MPP load operation
D	–	Grid monitoring
E	–	Disturbance
1	VCtlhhLim	Grid voltage limit level 2
2	VCtlhLim	Grid voltage limit level 1
3	–	Connection limit, maximum nominal voltage deviation

Position	Parameter	Description
4	–	Grid limit level 1 is breached, timer for B starts counting
5	–	Grid limit level 2 is breached, timer for A starts counting
6	–	Grid limit level 2 is breached for delay time level 2 → grid disconnection
7	–	Grid limit level 1 is breached for delay time level 1 → grid disconnection (has already occurred on level 2)
8	–	Connection conditions fulfilled → grid monitoring time starts counting
9	–	Utility grid within valid range during grid monitoring time → grid connection

13.1.3.2 Monitoring the Power Frequency

In the operating state "Grid monitoring", **Waiting for valid AC grid** appears on the touch display. The grid limits are monitored continuously from now on. If no grid error occurs during the grid monitoring time, the AC contactor closes and the inverter switches to the operating state "Grid monitoring time reached". If the grid limits are exceeded during the monitoring time, the inverter will restart "Grid monitoring".

You can specify the thresholds and delay times manually. For frequency monitoring, three thresholds can be configured for both overfrequency and underfrequency. For example, at an overfrequency of 50.5 Hz, tripping can take place after one second, and at an overfrequency of 51.5 Hz already after 0.1 seconds.

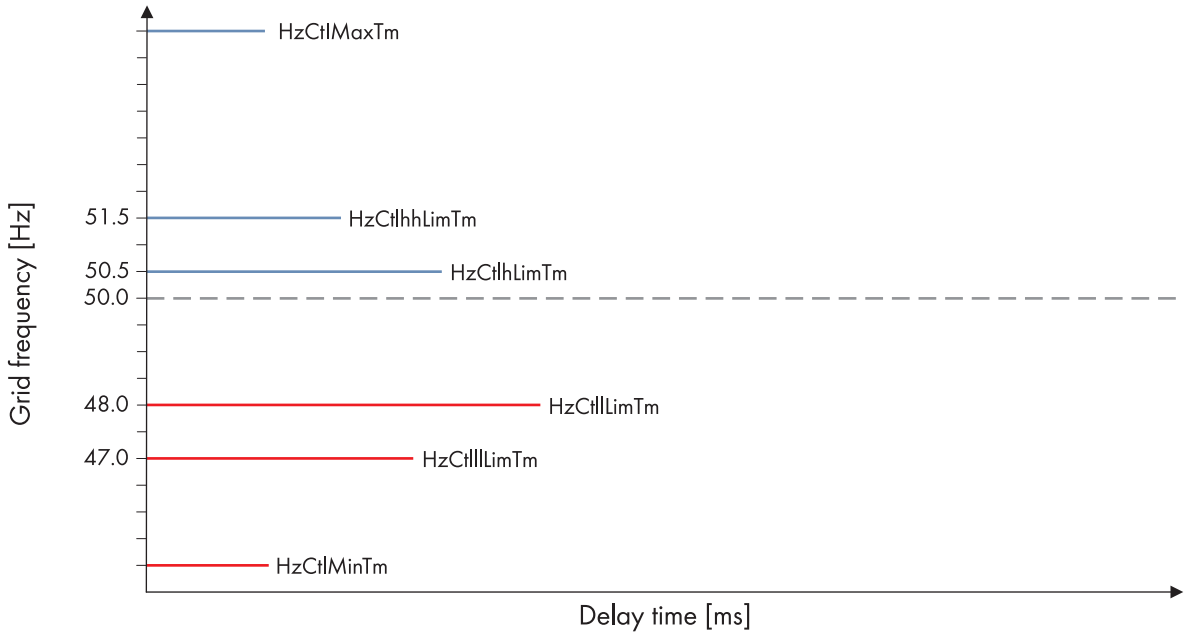


Figure 60: Tripping characteristics and time behavior as exemplified by frequency monitoring with the set parameters

13.1.4 Grid Monitoring Time Reached

The inverter is in the operating state "Grid monitoring time reached". **Waiting for PV voltage** or **Waiting for utilities company** appears on the touch display. If the input voltage V_{PV} exceeds the start voltage **PvVtgStrLevMin**, the inverter waits until the time specified in parameter **PvStrT** has elapsed. If the input voltage V_{PV} does not fall below the start voltage **PvVtgStrLevMin** during this time, the inverter checks whether the utility grid is connected. If a valid AC grid is connected, the inverter switches to the operating state "Startup". The start voltage **PvVtgStrLevMin** must be adjusted to conform with the PV array connected to the inverter.

13.1.5 Startup

13.1.5.1 In Normal Operation: Active Power Ramp-Up

The inverter works up to its maximum feed-in power via a ramp. This means that the inverter gradually increases the ratio of feed-in power per second by the value set in the parameter **WGra**.

13.1.5.2 After Grid Fault: Decoupling Protection Ramp

After a grid fault, the inverter restarts at a maximum of 10% nominal power per minute using a decoupling protection ramp. You have the option of switching this decoupling protection ramp on or off. If you deactivate the decoupling protection ramp, the inverter rapidly reverts to maximum power. If you wish to deactivate the decoupling protection ramp, contact us (see Section 17 "Contact", page 264).

13.1.6 Load Operation

13.1.6.1 MPP

In the MPP operating state, the inverter feeds power into the utility grid and operates permanently at the Maximum Power Point (MPP). **Operation** and the amount of power being fed in appear on the touch display. If the measured power P_{PV} during the time interval **PvPwrMinT** is less than the minimum feed-in power **PvPwrMin** or the key switch is set to **Stop**, the inverter switches to the operating state "Shutdown".

13.1.6.2 Q at Night

With the order option "Q at Night", the inverter can provide reactive power in order to stabilize the utility grid during non-feed-in operation, e.g. at night. This function is independent of normal feed-in operation. Only limited dynamic grid support is available in the operating state "Q at Night".

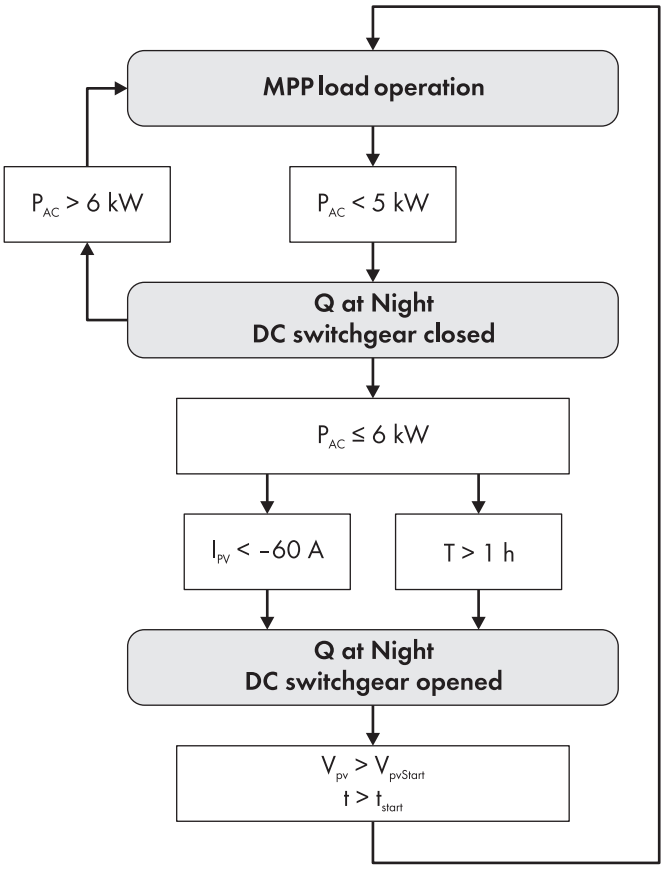


Figure 61: General overview of the operating states of the inverter in the operating state "Q at Night"

If the AC power generated by the inverter falls below 5 kW, the inverter switches from feed-in operation to "Q at Night" operation. The inverter feeds in reactive power in accordance with the parameter settings. Since this status can also occur during the day, the DC switchgear remains closed at first in order to avoid unnecessary switching cycles of the DC switchgear. If the inverter is in "Q at Night" operation for one hour or the DC current falls below −60 A, the DC switchgear opens. The inverter continues to feed in reactive power.

If reactive power feed-in is interrupted after a grid fault and the AC contactor is opened while the DC switchgear is open, the DC circuit is initially pre-charged. This reduces the stress on the electronic components. This process takes a maximum of one minute. Once the DC circuit is sufficiently pre-charged, the AC contactor is closed and the inverter monitors the grid limits. If all of the feed-in requirements are met, the inverter will revert to reactive power feed-in within one minute.

While the inverter is feeding in reactive power, the inverter monitors whether the conditions for active power feed-in are met. Once the feed-in requirements are met, the inverter closes the DC switchgear and switches to feed-in operation. To protect the PV array, the amount of reverse current is set by default to −60 A in the parameter **QoDInvCurPv**. This value must be adjusted according to the maximum permissible reverse current of the PV array.

13.1.7 Shutdown

The inverter is in the operating state "Shutdown". **Operation** appears on the touch display. If the key switch has been set to **Stop**, the inverter switches to the operating state "Stop". The AC contactor and the DC switchgear open automatically. If the inverter shuts down because the feed-in conditions are no longer met, the inverter switches to the operating state "Grid monitoring".

13.1.8 Disturbance

If a disturbance occurs during operation, the inverter displays a warning symbol in the touch display. The inverter behavior depends on the type of disturbance. Certain disturbances cause the inverter to shut down.

13.2 Safety Functions

13.2.1 Manual Shutdown Functions

13.2.1.1 External Fast Stop

The inverter comes equipped with a fast stop input. You have the option of connecting an external switch to this fast stop input which is activated via a 24 V signal. The external fast stop disconnects the inverter from the utility grid in less than 100 ms. The inverter is delivered with open terminals. The following options are available for configuring the external fast stop:

- **External fast stop is deactivated**

  The terminals of the active fast stop are bridged. The fast stop function is thus deactivated. You will need to bridge the terminals if required.

- **External fast stop operated with internal 24 V supply**

  An external switch (break contact) is connected to the inverter terminals via the internal supply voltage in the inverter. When the switch is closed, the relay is activated and the inverter feeds into the grid. If the fast stop is tripped, the switch opens and the relay is deactivated. The inverter is stopped and no longer feeds into the grid.

- **External fast stop operated with external 24 V supply**

  An external switch (break contact) is connected to the inverter terminals via an external 24 V power supply. When the switch is closed, the relay is activated and the inverter feeds into the grid. If the fast stop is tripped, the switch opens and the relay is deactivated. The inverter is stopped and no longer feeds into the grid.

Tripping the fast stop

The fast stop should only be tripped in case of imminent danger. Tripping of the fast stop does not entail fast discharge of the capacitors. If the inverter is to be switched off and properly shut down via an external signal, the remote shutdown input is to be used.

Fast stop input already assigned for order option "AC contactor"

If the MV Power Station is delivered with order option "AC contactor", the fast stop input for the voltage and frequency monitoring relay is already assigned. Thus, connecting an external switch is not possible.

13.2.1.2 Remote Shutdown

By means of remote shutdown, you can selectively shut down and switch off the inverter within approximately six seconds, for example, from a control room. The function of the remote shutdown is similar to the stop function of the key switch.

If the remote shutdown function is activated from the control room while the inverter is in the operating state "Grid monitoring", a motor drive automatically shuts off the DC switchgear and the inverter switches to the operating state "Stop".

If the remote shutdown unit is activated from the control room while the inverter is in the operating state "MPP load operation", the Sunny Central switches to the operating state "Shutdown". Once shutdown is complete, the AC contactor and the DC switchgear are switched off automatically and the inverter switches to the operating state "Stop".

The remote shutdown is designed as an open-circuit fail-safe function and must be connected to an external 24 V supply voltage. If 24 V is present in the remote shutdown, the inverter continues to operate in the current operating state. If the remote shutdown unit is tripped or if a wire-break occurs, 0 V is present in the remote shutdown unit and the inverter switches from the current operating state to the operating state "Stop".

Use of the remote shutdown will only be possible if the parameter **ExlStrStpEna** is set to **On**.

13.2.2 Automatic Shutdown Functions

13.2.2.1 Grid Management Shutdown

If the utility grid becomes unstable, grid management requires that the inverter disconnects from the utility grid immediately to avoid grid overload. In this event a corresponding Modbus signal will be transmitted by the grid operator or the safety system at the point of interconnection. The inverter disconnects from the utility grid immediately and displays error message **9013**. After another signal from the grid operator or the safety system at the point of interconnection, the error will be reset in the inverter.

13.2.2.2 Active Islanding Detection

The islanding detection function detects the formation of stand-alone grids and disconnects the inverter from the utility grid.

Islanding can occur when at the time of utility grid failure, the load in the shut-down sub-grid is roughly equivalent to the current feed-in power of the PV power plant.

With active islanding detection, the inverter continuously checks the stability of the utility grid. If the utility grid is intact, this has no impact on the utility grid. Only if a stand-alone grid has formed will the inverter disconnect from the utility grid.

To enable the active islanding detection function, contact us (see Section 17 "Contact", page 264).

13.2.2.3 Passive Islanding Detection

The inverter is equipped with passive islanding detection. This function can be activated if required. The islanding detection function detects the formation of stand-alone grids and disconnects the inverter from the utility grid.

Islanding can occur when at the time of utility grid failure, the load in the shut-down sub-grid is roughly equivalent to the current feed-in power of the PV power plant.

Unlike active islanding detection, with passive islanding detection the utility grid is not actively influenced, but simply passively monitored. This involves monitoring the speed of the frequency change.

If the power frequency changes by a certain amount in a certain time, a stand-alone grid is detected and the inverter disconnects from the utility grid. The magnitude of the frequency change and the time in which this change must take place can be configured via parameters on the grid monitoring relay.

13.2.3 Grounding and Insulation Monitoring

13.2.3.1 Mode of Operation

In grounded PV arrays

The ground-fault monitoring is implemented by means of a residual-current monitoring device. If a ground fault occurs, the residual currents are detected and interrupted.

- **Ground fault on the ungrounded terminal**

  If a ground fault occurs on the ungrounded terminal of the PV array, the normally ungrounded terminal of the PV array is grounded non-specifically by the ground fault and a residual current flows to the grounded terminal. This residual current flows through the ground-fault monitoring device, e.g. the GFDI, and triggers it.

- **Ground fault on the grounded terminal**

  The GFDI is bypassed when a ground fault occurs on the grounded terminal of the PV array. A ground fault on the grounded terminal cannot be reliably detected. If an undetected ground fault occurs on the grounded terminal, this will pose a safety risk. A further ground fault occurring on the ungrounded terminal will lead to high residual currents that cannot be interrupted by the ground-fault monitoring unit.

Residual current monitoring in grounded systems

In order to ensure the residual current monitoring function in grounded systems, the PV array insulation must be checked at regular intervals. It is therefore advisable to use an additional insulation monitoring device in grounded systems. This will enable the insulation to be checked at regular intervals.

In ungrounded PV arrays

An insulation monitoring device constantly determines the insulation resistance using an active measurement procedure. As soon as the insulation resistance falls below the warning threshold specified in the insulation monitoring device, an insulation warning will appear on the touch display. As a result, preventative measures can be taken before errors such as personal injury due to leakage currents or system failure occur. If the insulation resistance falls below the configured warning threshold, the PV power plant switch off. Use the parameter **IsoErrIgn** to activate or deactivate the disconnection process under fault conditions.

13.2.3.2 GFDI

Depending on the order option, ground-fault monitoring in the inverter may be carried out via ground fault detection and interruption (GFDI). This grounds one terminal of the PV array. GFDI is performed via a high-performance K-type circuit breaker with adjustable operating current. The GFDI is integrated in the inverter and connected between an input busbar and the grounding busbar.

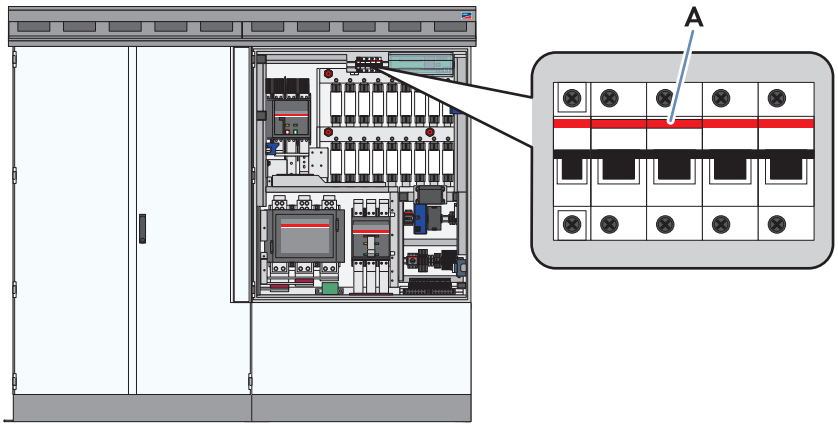


Figure 62: GFDI

Position	Designation
A	GFDI

13.2.3.3 Remote GFDI

Depending on the order option, ground fault monitoring in the inverter may be carried out via ground fault detection and interruption with motor drive, in short "Remote GFDI". This grounds one terminal of the PV array. Remote GFDI also enables automatic error processing. This reduces downtimes and avoids service calls due to temporary insulation errors such as when condensation occurs on the PV modules. Remote GFDI is performed via a high-performance K-type circuit breaker with adjustable operating current. The remote GFDI is integrated in the inverter and connected between an input busbar and the grounding busbar.

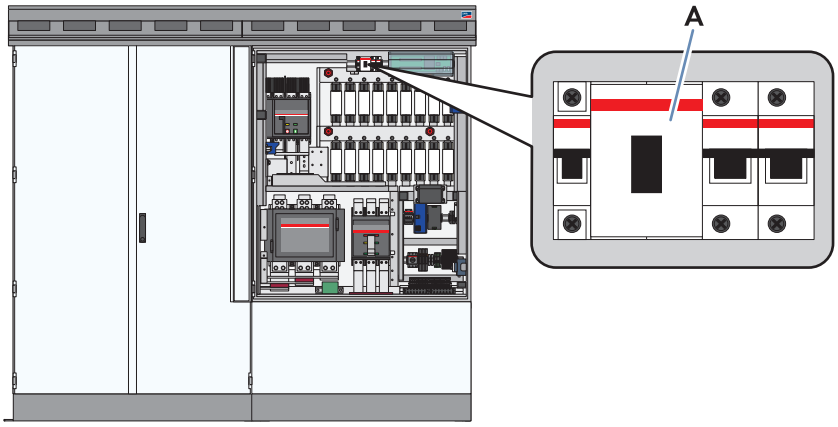


Figure 63: Remote GFDI

Position	Designation
A	Remote GFDI

If the Remote GFDI trips, initially a temporary error will be assumed and a motor drive will close the Remote GFDI after a defined waiting time. No external switch command is required to close the tripped Remote GFDI. The inverter can switch back to feed-in operation after a waiting time. In the default setting of the inverter, the software will attempt to start the Remote GFDI up to three times per day. If the Remote GFDI is tripped on several consecutive days, the software assumes a permanent insulation error and the inverter will no longer switch back on. In this case, a qualified person will need to check and, if necessary, repair the insulation and then acknowledge the error.

13.2.3.4 Insulation Monitoring Device

Depending on the order option, an insulation monitoring device can monitor the insulation resistance of the PV power plant in ungrounded PV arrays.

In the operating state "MPP load operation", the insulation resistance of the entire system, from the PV array to the MV transformer, will be measured.

If the inverter is in the operating state "Grid monitoring", only the insulation resistance from the PV array to the inverter will be measured.

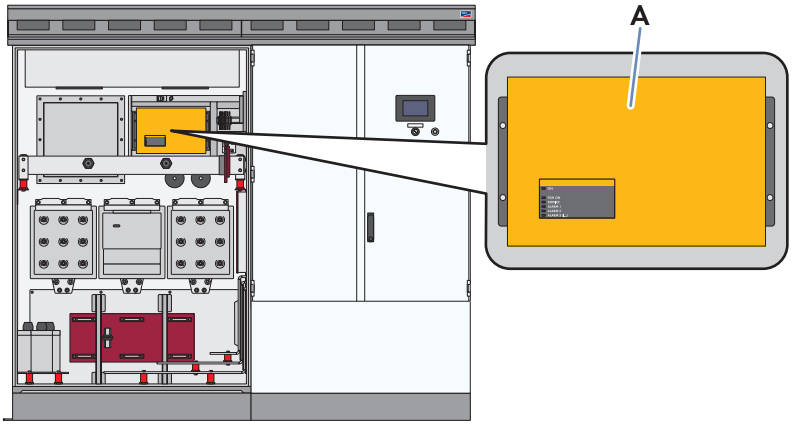


Figure 64: Insulation monitoring device

Position	Designation
A	Insulation monitoring device

A measuring circuit and a relay with a change-over contact are integrated in the insulation monitoring device.

The insulation monitoring device is connected between the PV voltage and the grounding conductor. The contacts of the relay are routed to the customer terminal plate and can be used by the customer to trip a signal light or siren. The characteristics of the relay are indicated in the circuit diagram.

If the insulation resistance falls below the warning threshold specified in the parameter **RisoCtlWarn**, the measuring circuit closes and the LED **ALARM1** on the insulation monitoring device is glowing. The error message **3601 – Warning insulation failure** is generated by the inverter. Simultaneously, the insulation monitoring device activates the relay with change-over contact. This relay is installed in the inverter.

If the insulation resistance falls below the error threshold (1 kΩ), an insulation error has occurred and the LEDs **ALARM1** and **ALARM2** on the insulation monitoring device are glowing. In this case, the operating behavior of the inverter can be set via parameters as follows:

- If the parameter **IsoErrIgn** is set to **Off**, the measuring circuit issues a disturbance when the insulation resistance falls below the error threshold, the inverter switches off and issues the error message **3501 - Insulation Failure**. The LEDs **ALARM1** and **ALARM2** are glowing.
- If the parameter **IsoErrIgn** is set to **On**, the error message from the measuring circuit is ignored when the insulation resistance falls below the error threshold. The inverter continues to feed into the grid and generates the error message **3504 – Insulation failure ignored**.
- If the parameter **IsoErrIgn** is set to **Run** and the insulation resistance falls below the error threshold, the error message from the measuring circuit will only be ignored if the inverter is in feed-in operation. In feed-in operation, the inverter continues to feed into the grid and generates the error message **3504 – Insulation failure ignored**.

  If the insulation resistance falls below the error threshold in another operating state, the error is not ignored and the inverter does not switch to feed-in operation. The error message **3501 – Insulation Failure** appears on the touch display. The LEDs **ALARM1** and **ALARM2** are glowing.

Type of insulation monitoring device used

The insulation monitoring device used is the A-ISOMETER iso-PV1685 device supplied by Bender GmbH & Co. KG.

13.2.3.5 GFDI and Insulation Monitoring Device

With the order option "GFDI and Insulation Monitoring", it is possible to temporarily disable the PV array grounding and to check the insulation via the integrated insulation monitoring device.

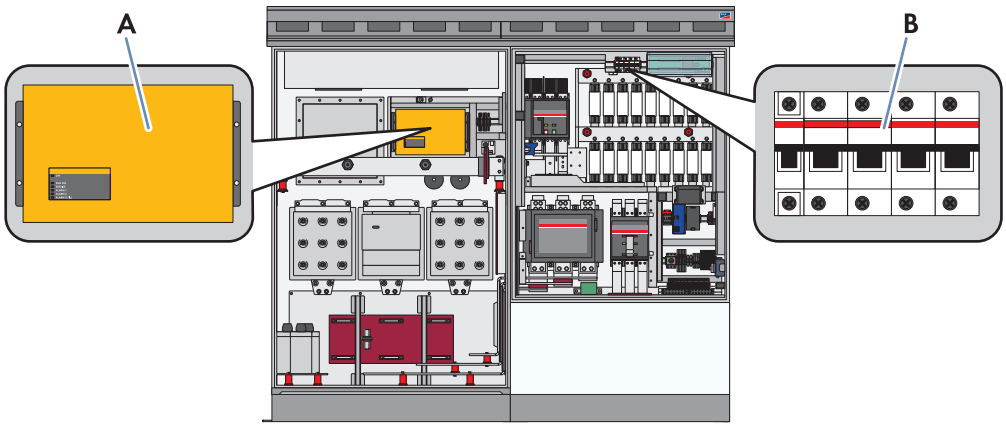


Figure 65: GFDI and insulation monitoring

Position	Designation
A	Insulation monitoring device
B	GFDI

When the GFDI is closed, the PV array is grounded. In this state, the insulation resistance cannot be determined.

When the GFDI is open, grounding is disabled. In this state, the insulation monitoring device continuously measures the insulation resistance. In the operating state "MPP load operation", the insulation resistance of the entire system, from the PV array to the MV transformer, will be measured. If the inverter is in the operating state "Grid monitoring", only the insulation resistance from the PV array to the inverter will be measured.

Insulation monitoring should be performed in the operating state "MPP load operation". This will ensure that all parts of the system are included in the insulation measurement.

Insulation monitoring

The insulation monitoring device will start measuring once the GFDI is open. The insulation monitoring device will initially assume that the insulation is poor. If the parameter **IsoErrIgn** is set to **Off**, the inverter will switch off temporarily.

The insulation monitoring device takes approximately five minutes to detect the correct insulation resistance. The value of the insulation resistance can be read off from the user interface in the instantaneous value **Riso**. If the insulation is intact, the inverter switches back to the operating state "MPP load operation." Once the insulation monitoring process is complete, the GFDI should be closed again, thus enabling the PV array to revert to grounded operation.

If after approximately five minutes one of the errors **3501 – Insulation Failure**, **3504 – Insulation failure ignored** or **3601 – Warning insulation error** is displayed, the insulation is defective. In this case, a qualified person will need to check and, if necessary, repair the insulation and then acknowledge the error.

Type of insulation monitoring device used

The insulation monitoring device used is the A-ISOMETER iso-PV1685 device supplied by Bender GmbH & Co. KG.

13.2.3.6 Remote GFDI and Insulation Monitoring Device

With the order option "Remote GFDI and Insulation Monitoring", it is possible to automatically correct errors which have occurred, to temporarily disable the grounding connection of the PV array and to check the insulation with the integrated insulation monitoring device.

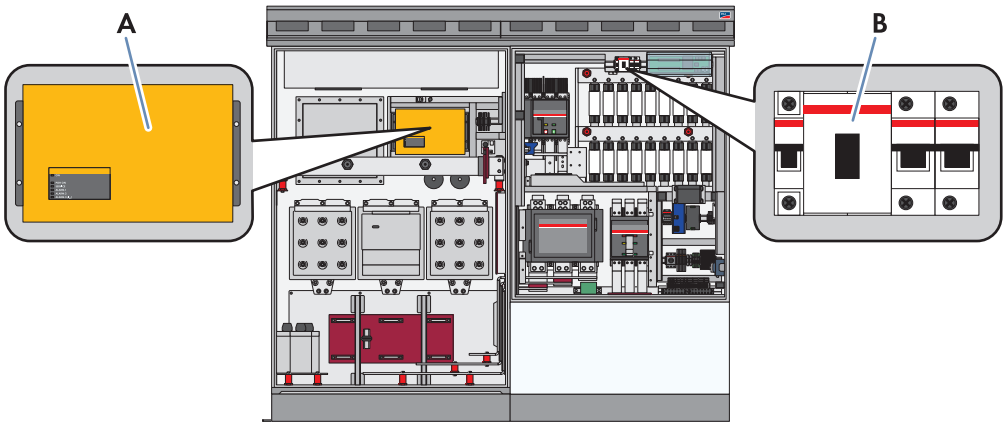


Figure 66: Remote GFDI and Insulation Monitoring Device

Position	Designation
A	Insulation monitoring device
B	Remote GFDI

When the Remote GFDI is closed, the PV array is grounded. In this state, the insulation resistance cannot be determined. If the Remote GFDI trips, initially a temporary error will be assumed and a motor drive will close the Remote GFDI after a defined waiting time. No external switch command is required to close the tripped Remote GFDI. The inverter can switch back to feed-in operation after a waiting time.

In the default setting of the inverter, the software will attempt to start the Remote GFDI up to three times per day.

If the Remote GFDI is tripped on several consecutive days, the software assumes a permanent insulation error and the inverter will no longer switch back on. In this case, a qualified person will need to check and, if necessary, repair the insulation and then acknowledge the error.

When the Remote GFDI is open, the grounding connection is disabled. In this state, the insulation monitoring device continuously measures the insulation resistance. In the operating state "MPP load operation", the insulation resistance of the entire system, from the PV array to the MV transformer, will be measured. If the inverter is in the operating state "Grid monitoring", only the insulation resistance from the PV array to the inverter will be measured.

Insulation monitoring should be performed in the operating state "MPP load operation". This will ensure that all parts of the system are included in the insulation measurement.

Insulation monitoring

To disable the grounding of the PV array, the parameter **RemMntSvc** must be set to **On**. This will open the Remote GFDI by means of a motor drive.

If the Remote GFDI has been opened by a motor drive via the parameter **RemMntSvc**, the insulation monitoring device will start measuring after the waiting time defined in parameter **IsoMeasDly** has elapsed. This allows the insulation monitoring device to determine the insulation resistance without interrupting feed-in operation. If an insulation error is present, this will only be taken into account at the end of the waiting time.

Once the insulation monitoring process is complete, the parameter **RemMntSvc** should be set to **Off**, thus switching the PV array into grounded operation.

If after approximately five minutes one of the errors **3501 – Insulation Failure**, **3504 – Insulation failure ignored** or **3601 – Warning insulation failure** is displayed, the insulation is defective. In this case, a qualified person will need to check and, if necessary, repair the insulation and then acknowledge the error.

Type of insulation monitoring device used

The insulation monitoring device used is the A-ISOMETER iso-PV1685 device supplied by Bender GmbH & Co. KG.

13.3 Power Control

13.3.1 Frequency-Dependent Active Power Limitation

With frequency-dependent active power limitation, the inverter constantly checks the connected power frequency. If the active power is to be limited by a hysteresis, the parameter **WCtlHzMod** must be set to **CurveHys**.

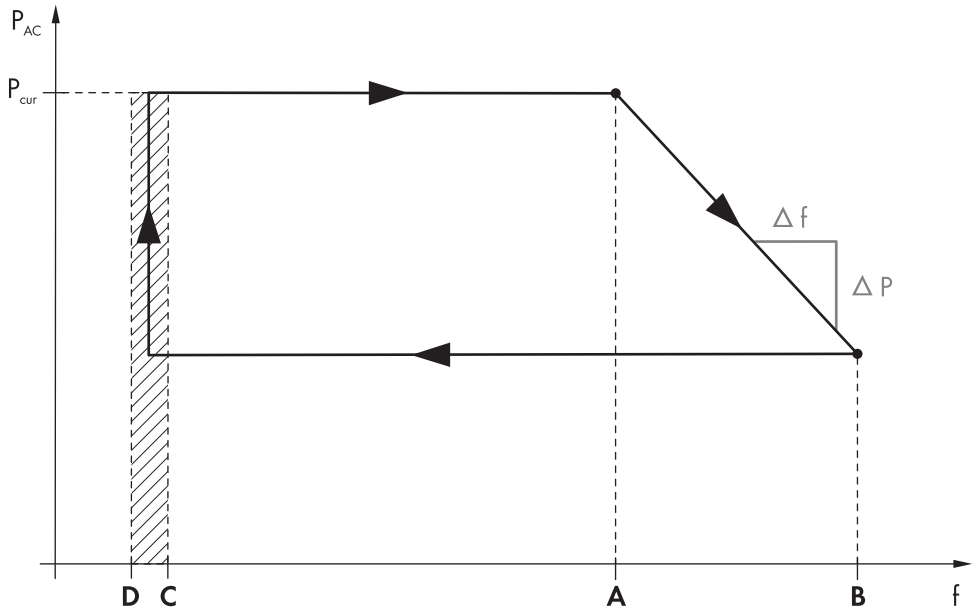


Figure 67: Power behavior of the inverter when the frequency limit P-HzStr is exceeded

If the power frequency exceeds a threshold defined in the parameter **P-HzStr**, shown here at point A, the inverter will store the current feed-in power P_{cur}. The reduced feed-in power is calculated based on this saved value. The reduction of the feed-in power is defined via the parameter **P-WGra**. This parameter indicates the percentage of the saved power P_{cur} by which the power per Hz will be reduced if the power frequency continues to rise. If the power frequency decreases again as shown in point B, the last feed-in power value reached will remain valid. Only when the power frequency falls below the threshold defined in the parameter **P-HzStop**, as shown here at point C, can the feed-in power be increased again. In this case, the saved value P_{mom} forfeits its validity. In addition, a minimum threshold for power frequency shortfall can be defined with the parameter **P-HzStopMin**, shown here at point D. If the power frequency falls below the grid limit, the inverter will shut down and switch to the operating state "Grid monitoring". The inverter will remain in the operating state "Grid monitoring" until all feed-in conditions are fulfilled again.

Calculation of the power limit:

$$P_{max} = P_{cur} - [(f_{AC} - \text{P-HzStr}) \cdot \text{P-WGra} \cdot P_{cur}]$$

P_{max}	Power limit	P_{cur}	Current power
f_{AC}	Power frequency	P-WGra	Gradient for reducing active power
P-HzStr	Selected frequency limit from which feed-in power will be reduced		

Example:

An inverter with 500 kW is feeding 350 kW (P_{cur}) into the utility grid. The frequency will reach up to 51.2 Hz. The difference between the current power frequency and **P-HzStr** (51.2 Hz – 50.2 Hz) multiplied by the gradient **P-WGra** (40%/Hz) results in an active power reduction of 40% of the last available power P_{cur} (350 kW). This results in a power limitation of 140 kW and thus a maximum active power of 210 kW.

Calculation:

210 kW = 350 kW – [(51.2 Hz – 50.2 Hz) · 40%/Hz · 350 kW]

13.3.2 Frequency-Independent Active Power Limitation

13.3.2.1 No Active Power Limitation: Off Mode

The feed-in power is limited to the parameter **Pmax**.

The parameter **Pmax** defines the inverter power at the feed-in point and is adjusted to the local conditions during commissioning. The parameter **Pmax** can only be changed when the device is in the operating state "Stop" and the installer password has been entered.

13.3.2.2 Active Power Limitation with Setpoint Command via Modbus Protocol: WCtlCom Mode

The communication unit receives the setpoint for active power limitation and transmits it to the inverter. If the inverter has received no signal for five minutes, an error message will be displayed in the instantaneous value **P-WModFailStt** .

13.3.2.3 Active Power Limitation with Absolute Value: WCnst Mode

The active power limitation is entered as an absolute value via the parameter **P-W**. The parameter **P-W** defines the active power to be fed in. The parameter **P-W** can be changed in feed-in operation. The parameter **P-W** must not be greater than the parameter **Pmax**.

13.3.2.4 Active Power Limitation as a Percentage of Nominal Power: WCnstNom Mode

The active power limitation is set as a percentage value via the parameter **P-WNom**. The percentage value refers to the parameter **Pmax**. The parameter **P-WNom** indicates what percentage of the maximum possible power is to be fed in. The parameter **P-WNom** can be changed during feed-in operation.

13.3.2.5 Active Power Limitation via Standard Signal: WCnstNomAnIn Mode

The active power limitation is set via an analog signal at the input terminals for the setpoint. This is usually implemented by a ripple control signal. The electrical current strength of the connected signal determines the nominal active power. The analog measured values must be between 4 mA and 19 mA. If the analog signal is less than 2 mA, an error message will be displayed in the instantaneous value **P-WModFailStt**.

Signal	Power limit	Description
< 2 mA	Last valid value or **Pmax** after restart	Signal is in the invalid range.
2 mA to 4 mA	0 kW	No power is fed into the grid.
4 mA to 19 mA	0 kW to **Pmax**	The energy fed into the grid is determined by a characteristic curve.
> 19 mA	**Pmax**	The energy fed into the grid equals **Pmax**.

The analog value is converted to a setpoint for power limitation. Here, the parameter **Pmax** forms the end point of the linear characteristic curve.

13.3.3 Reactive Power Control

13.3.3.1 No Reactive Power Control: Off Mode

The reactive power setpoint is limited to 0 kVAr. This setpoint cannot be controlled.

13.3.3.2 Reactive Power Control with Setpoint Command via Modbus Protocol: VArCtlCom Mode

The reactive power setpoint is received by the communication unit and transmitted to the inverter. The setpoint is transmitted as a percentage value and converted to kVAr in the device. If the inverter has not received any signal for five minutes, the error message **Q-VArModFailStt** will be displayed.

13.3.3.3 Reactive Power Control with Setpoint Command via Modbus Protocol: PFCtlCom Mode

The reactive power setpoint is received by the communication unit and transmitted to the inverter. The setpoint is transmitted as a displacement power factor cos φ. If the inverter has not received any signal for the last five minutes, an error message will be displayed in the instantaneous value **Q-VArModFailStt**.

13.3.3.4 Reactive Power Control with Absolute Value: VArCnst Mode

The reactive power setpoint is set via the parameter **Q-VAr**. The parameter **Q-VAr** is permitted to be within the range from **–Qmax** to **+Qmax**.

13.3.3.5 Reactive Power Control as a Percentage of the Nominal Power: VArCnstNom Mode

The parameter **Q-VArNom** is used to set the reactive power setpoint in %. The parameter **Q-VArNom** refers to **Pmax**. If the calculated amount of reactive power exceeds the predefined value of **Qmax**, the power will be limited to **Qmax**. If the calculated amount of reactive power falls below the predefined value of **–Qmax**, the power will be limited to **–Qmax**.

13.3.3.6 Reactive Power Setpoint via Standard Signal: VArCnstNomAnIn Mode

The reactive power setpoint is set at the input terminals for the setpoints via an analog signal. This is usually implemented by a ripple control signal. The analog value is converted into a reactive power setpoint. The electrical current strength of the connected signal determines the setpoint. The analog measured values must be between 4 mA and 19 mA. If the analog signal is less than 2 mA, an error message will be displayed in the instantaneous value **Q-VArModFailStt**.

Signal	Power limit	Description
< 2 mA	Last valid mean value or 0 kVAr after restart	Signal is in the invalid range.
2 mA to 4 mA	**Qmax** / underexcited	The maximum amount of negatively excited reactive power is fed in.
4 mA	**Qmax** / underexcited	Start point of the characteristic curve The maximum amount of negatively excited reactive power is fed in.

Signal	Power limit	Description
11.5 mA	0 kVAr	Zero-crossing of the characteristic curve No reactive power is fed in.
> 19 mA	**Qmax** / overexcited	End point of the characteristic curve The maximum amount of positively excited reactive power is fed in.

The analog value is converted to a setpoint for power limitation. Here, the parameter **Qmax** forms the end point of the linear characteristic curve.

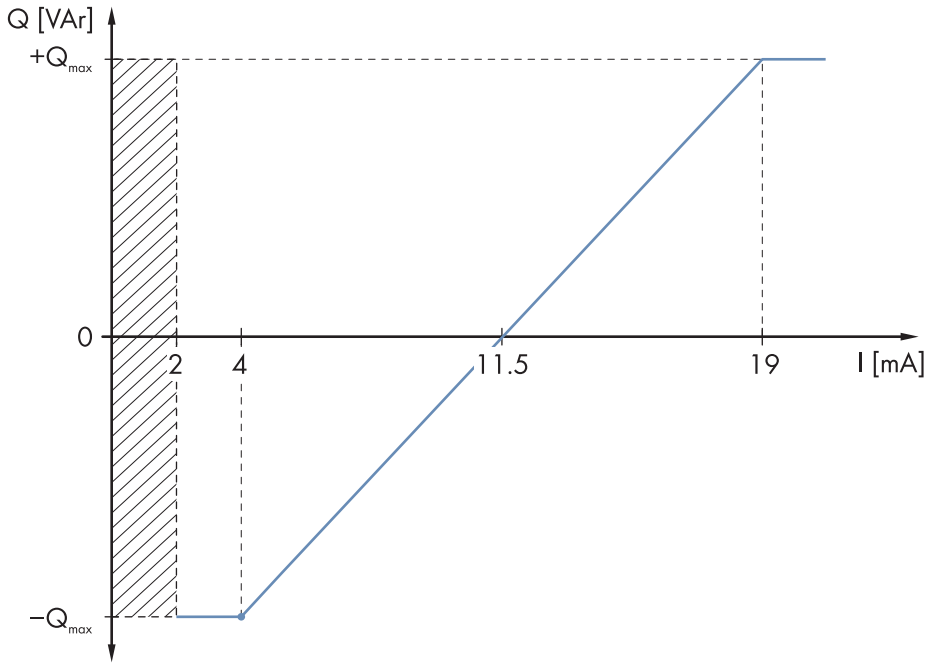


Figure 68: Limitation of the reactive power to the parameter **Qmax**

13.3.3.7 Reactive Power Setpoint via Displacement Power Factor cos φ: PFCnst Mode

The reactive power setpoint is set via the parameters **PF-PF** and **PF-PFExt**. The parameter **PF-PF** indicates the displacement power factor cos φ and the parameter **PF-PFExt** indicates the degree of overexcitation or underexcitation.

13.3.3.8 Displacement Power Factor cos φ via Standard Signal: PFCnstAnIn Mode

The reactive power setpoint is set at the input terminals for the setpoints via an analog signal. This is usually implemented by a ripple control signal. The analog value is converted into a displacement power factor cos φ. The electrical current strength of the connected signal determines the setpoint. The analog measured values must be between 4 mA and 19 mA. If the analog signal is less than 2 mA, an error message will be displayed in the instantaneous value **Q-VArModFailStt**.

Signal	Power limit	Description
< 2 mA	Last valid mean value or 0 kVAr after restart	Signal is in the invalid range.
2 mA to 4 mA	**PFAbsMin**/underexcited	The maximum amount of negatively excited reactive power is fed in.

Signal	Power limit	Description
4 mA	**PFAbsMin**/underexcited	Start point of the characteristic curve The maximum amount of negatively excited reactive power is fed in.
11.5 mA	0 kVAr	Zero-crossing of the characteristic curve No reactive power is fed in.
> 19 mA	**PFAbsMin** / overexcited	End point of the characteristic curve The maximum amount of positively excited reactive power is fed in.

The analog value is converted into a setpoint for the displacement power factor cos φ. Here, the parameter **PFAbsMin** is the starting and end point of the linear characteristic curve.

13.3.3.9 Displacement Power Factor cos φ as a Function of Feed-In Power: PFCtlW Mode

In the **PFCtlW** mode, the displacement power factor cos φ is set as a function of feed-in power. This dependency is depicted by a configurable characteristic curve. The characteristic curve can be configured as increasing or decreasing. The start and end points of the characteristic curve can be configured by means of parameters.

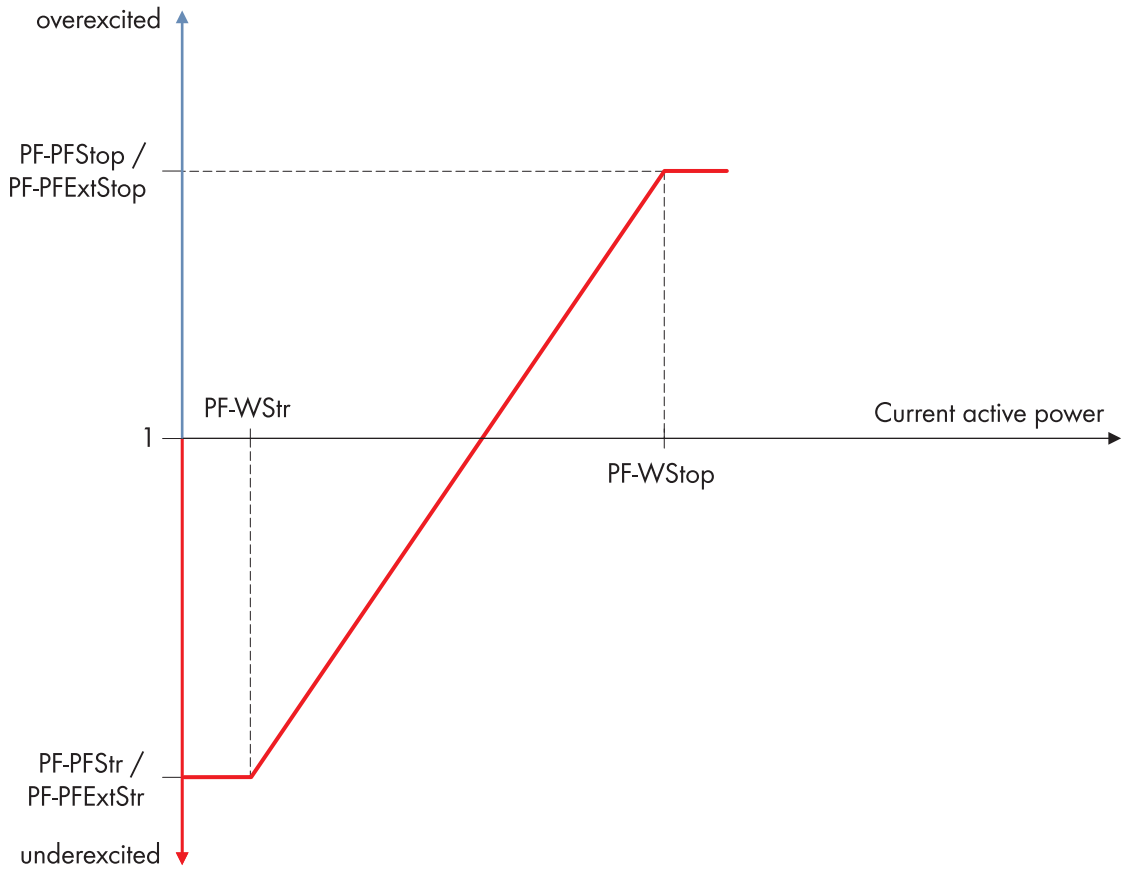


Figure 69: Characteristic curve for reducing reactive power as a function of active power

On the basis of a linear characteristic curve with an upper and lower cap, a displacement power factor cos φ can be regulated depending on the active power currently being fed in. The start and end points of the characteristic curve can be configured by means of parameters. The shape of the characteristic curve is determined by the start and end points.

13.3.3.10 Reactive Power as a Function of the Grid Voltage: VArCtlVol Mode

Consultation prior to parameter change

The parameters of this mode can only be selected or changed after consultation (see Section 17 "Contact", page 264).

The reactive power is set as a function of the grid voltage. The reactive power setpoint is adjusted in stages.

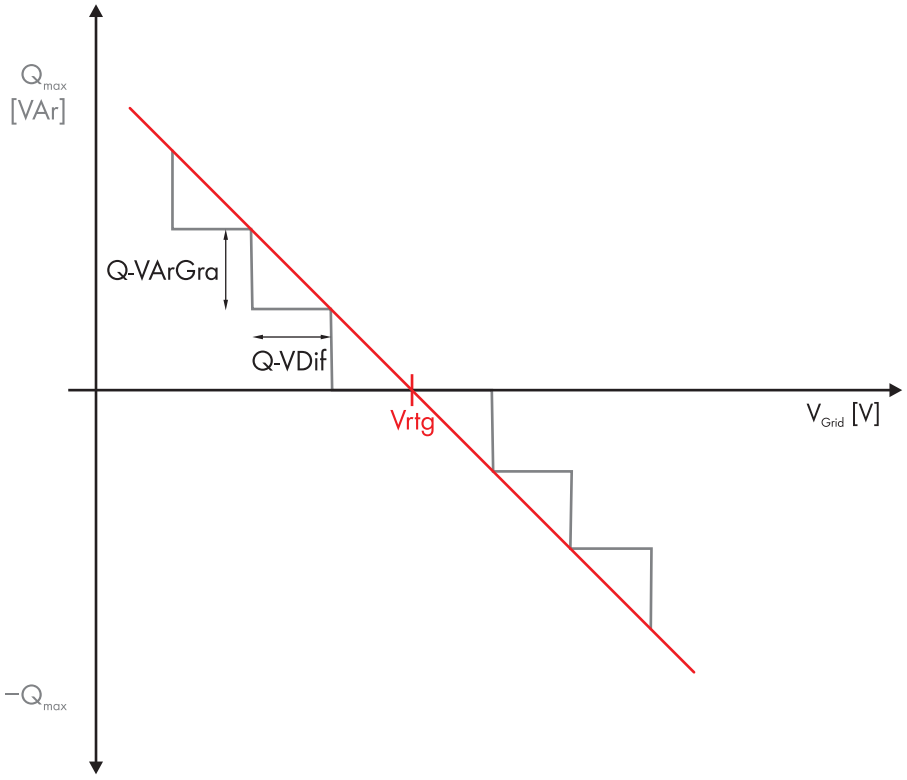


Figure 70: Characteristic curve for reducing reactive power as a function of the grid voltage

If the grid voltage is changed by the configurable voltage difference **Q-VDif** for the configurable duration of **Q-VDifTm**, the reactive power setpoint will be adjusted by the value **Q-VArGra.** The parameterization of this function refers to the medium voltage.

13.3.3.11 Measures for Voltage Support through Parameterization of Reactive Power/ Voltage Characteristic Curve: VArCtlVolHystDb Mode

Consultation prior to parameter change

The parameters of this mode can only be selected or changed after consultation (see Section 17 "Contact", page 264).

By supplying reactive power, the inverter performs voltage-stabilizing measures in the event of overvoltage or undervoltage. The parameterization is carried out by means of a reactive power/voltage characteristic curve. The characteristic curve can be flexibly configured by parameterizing the slope, a type of deadband through two voltage points and a hysteresis.

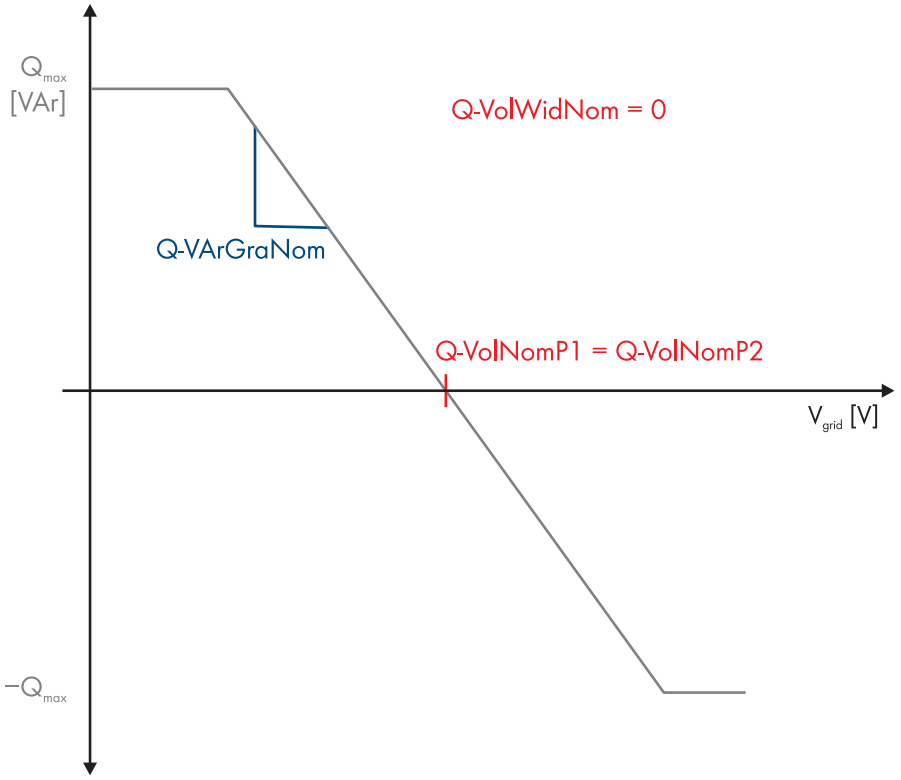


Figure 71: Characteristic curve for reducing reactive power without deadband and without hysteresis

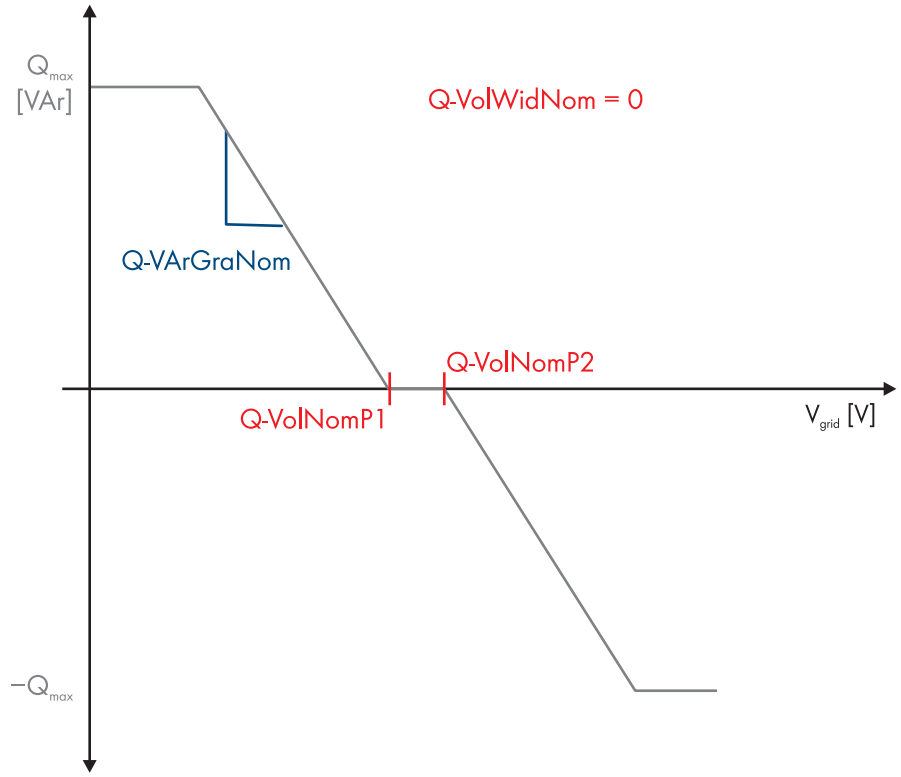


Figure 72: Characteristic curve for reducing reactive power with deadband and without hysteresis

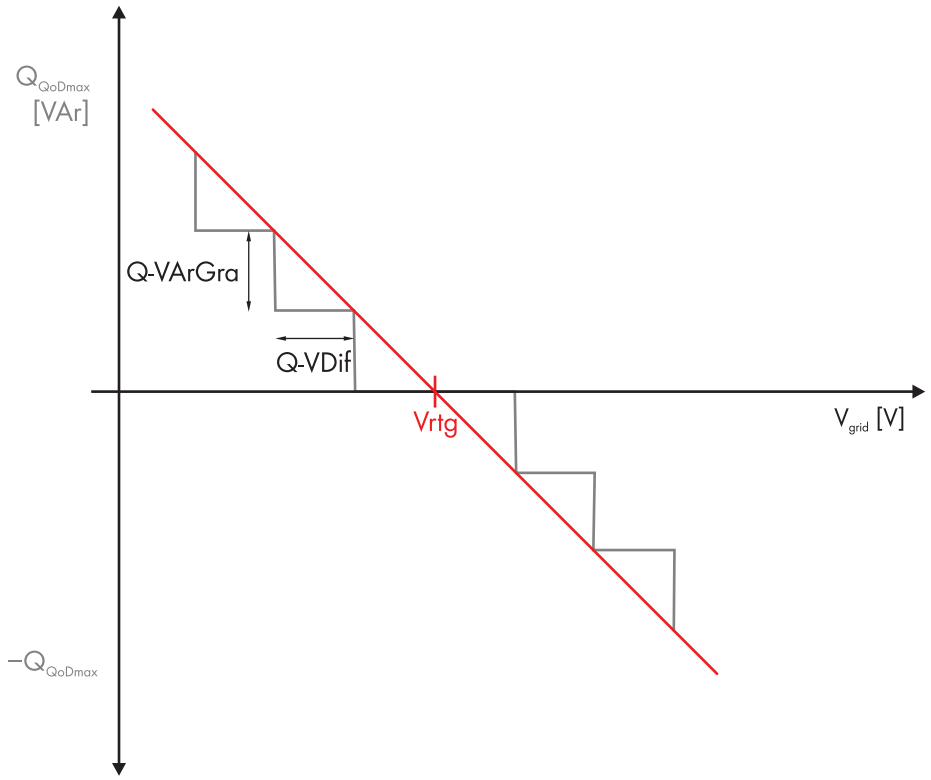


Figure 73: Characteristic curve for reducing reactive power with hysteresis

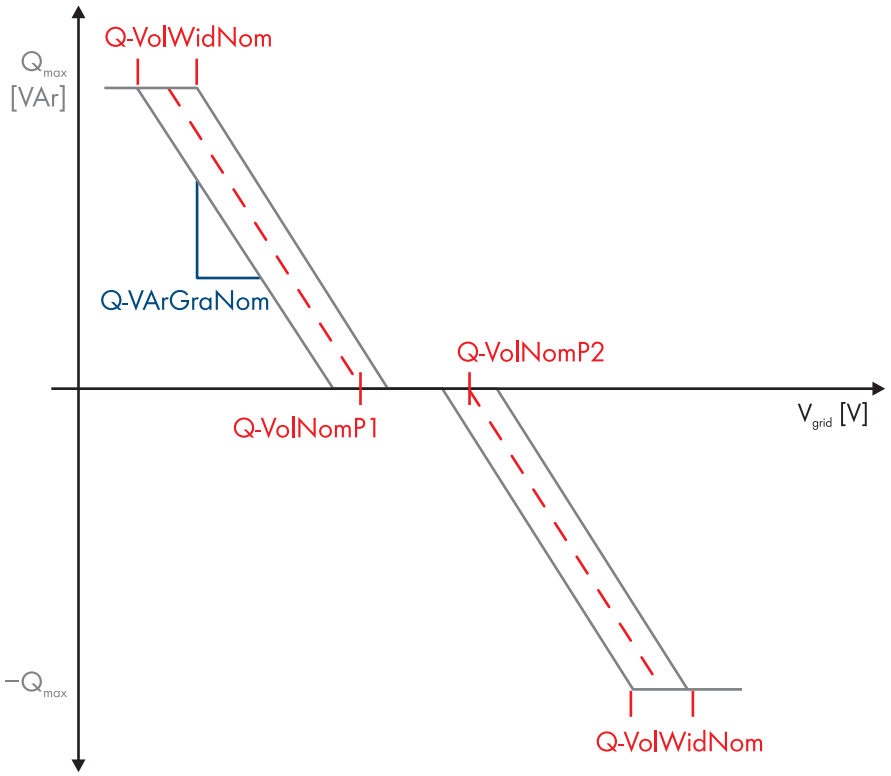


Figure 74: Characteristic curve for reducing reactive power with deadband and hysteresis

The parameter **Q-VArTmsSpnt** determines the delay time which must elapse before the calculated reactive power setpoint is actively used. In order to prevent mutual interference of several systems with this function, the parameter **Q-VArTmsVtg** can be used to set a delay time. This delay time defines how long a voltage change must be pending before a change in reactive power feed-in is triggered. Consequently, control of the grid voltage at the grid feed-in point can be staggered across several systems. You can activate and deactivate the delay time by means of the parameter **Q-EnaTmsVtg**.

13.3.3.12 Measures for Voltage Support through Parameterization of Reactive Power/Voltage Characteristic Curve: VArCtlVolHystDbA Mode

Parameter block

Some parameters must only be changed in the operating state "Stop". The entry will not be accepted in any other operating state.

By supplying reactive power, the inverter performs voltage-stabilizing measures in the event of overvoltage or undervoltage. The parameterization is carried out by means of a reactive power/voltage characteristic curve. The characteristic curve can be configured flexibly by parameterization of the slopes, a type of deadband through two voltage points, a hysteresis and the thresholds for activation.

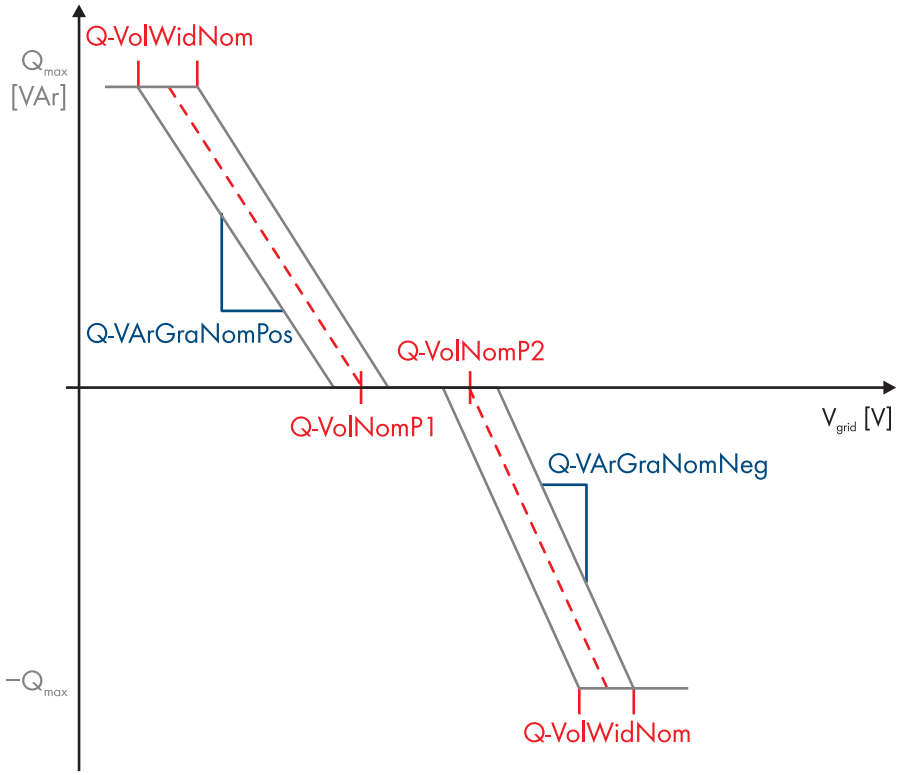


Figure 75: Characteristic curve for reducing reactive power with deadband and hysteresis

The parameter **Q-VArTmsSpnt** determines the delay time which must elapse before the calculated reactive power setpoint is actively used.

In order to prevent mutual interference of several systems with this function, the parameter **Q-VArTmsVtg** can be used to set a delay time. This delay time defines how long a voltage change must be pending before a change in reactive power feed-in is triggered. Consequently, control of the grid voltage at the grid feed-in point can be staggered across several systems.

You can activate and deactivate the delay time by means of the parameter **Q-EnaTmsVtg**.

In addition, the parameter **Q-VLockInW** can be used to define a voltage at which reactive power control will be activated after the time specified in parameter **Q-VLockInTm** has elapsed. If the voltage exceeds the threshold defined in parameter **Q-VLockOutW**, the reactive power control will be deactivated once the time specified in parameter **Q-VLockOutTm** has elapsed.

13.3.4 Q at Night

13.3.4.1 No Q at Night: Off Mode

The reactive power setpoint is limited to 0 kVAr. This setpoint cannot be controlled.

13.3.4.2 Q at Night with Operation Command via Modbus Protocol: VArCtlCom Mode

The reactive power setpoint is received by the communication unit and transmitted to the inverter. The setpoint is transmitted as a percentage value and converted to kVAr in the device. If the inverter has not received any signal for five minutes, the error message **Q-VArModFailStt** will be displayed.

13.3.4.3 Q at Night with Absolute Value: VArCnst Mode

The reactive power setpoint is set via the parameter **QoDQ-VAr**. The parameter **QoDQ-VAr** is permitted to be within the range from **–QoDQmax** to **+QoDQmax**.

13.3.4.4 Q at Night as a Percentage of the Nominal Power: VArCnstNom Mode

The parameter **QoDQ-VArNom** is used to set the reactive power setpoint in %. The parameter **QoDQ-VArNom** refers to **Pmax**. If the calculated amount of reactive power exceeds the predefined value of **QoDQmax**, it will be limited to **QoDQmax**. If the calculated amount of reactive power falls below the predefined value of **–QoDQmax**, it will be limited to **–QoDQmax**.

13.3.4.5 Q at Night via Standard Signal: VArCnstNomAnIn Mode

The reactive power setpoint is set at the input terminals for the setpoints via an analog signal. This is usually implemented by a ripple control signal. The analog value is converted into a reactive power setpoint. The electrical current strength of the connected signal determines the setpoint. The analog measured values must be between 4 mA and 19 mA. If the analog signal is less than 2 mA, an error message will be displayed in the instantaneous value **Q-VArModFailStt**.

Signal	Power limit	Description
< 2 mA	Last valid mean value or 0 kVAr after restart	Signal is in the invalid range.
2 mA to 4 mA	**–QoDQmax** / underexcited	The maximum amount of negatively excited reactive power is fed in.
4 mA	**–QoDQmax** / underexcited	Start point of the characteristic curve The maximum amount of negatively excited reactive power is fed in.
11.5 mA	0 kVAr	Zero-crossing of the characteristic curve No reactive power is fed in.
> 19 mA	**+QoDQmax** / overexcited	End point of the characteristic curve The maximum amount of positively excited reactive power is fed in.

The analog value is converted to a setpoint for power limitation. Here, the parameter **QoDQmax** is the end point of the linear characteristic curve.

13.3.4.6 Q at Night Depending on the Grid Voltage: VArCtlVol Mode

Consultation prior to parameter change

The parameters of this mode can only be selected or changed after consultation (see Section 17 "Contact", page 264).

The reactive power is set as a function of the grid voltage. The reactive power setpoint is adjusted in stages.

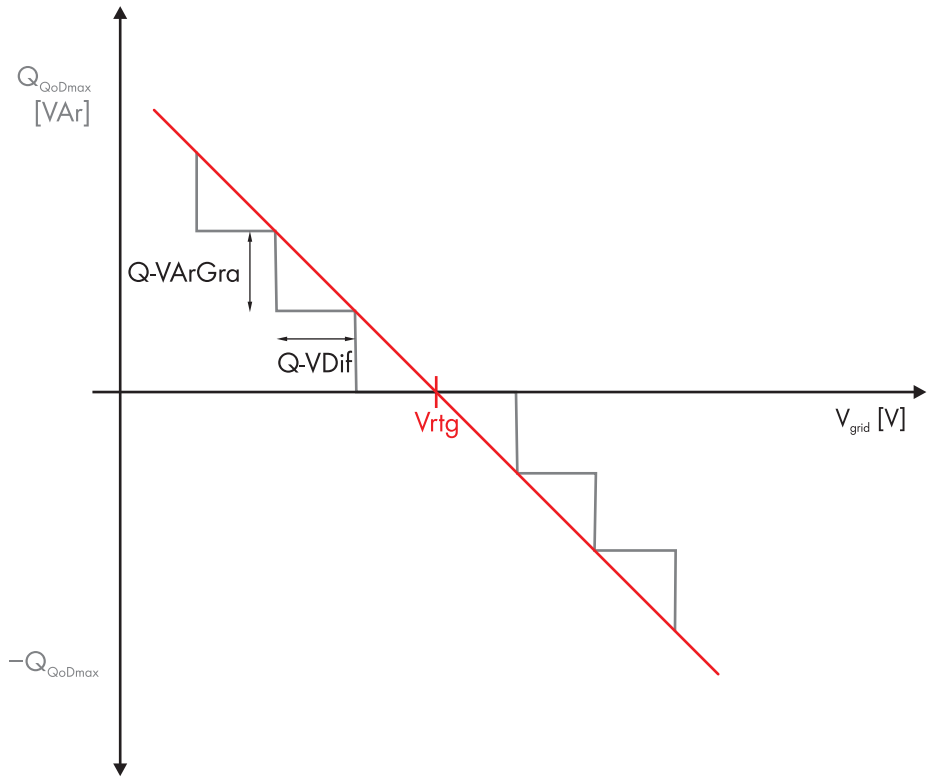


Figure 76: Characteristic curve for reducing reactive power as a function of the grid voltage

If the grid voltage is changed by the configurable voltage difference **Q-VDif** for the configurable duration of **Q-VDifTm**, the reactive power setpoint will be adjusted by the value **Q-VArGra.** The parameterization of this function refers to the medium voltage.

13.3.4.7 Measures for Voltage Support through Parameterization of Reactive Power/ Voltage Characteristic Curve: VArCtlVolHystDb Mode

Consultation prior to parameter change

The parameters of this mode can only be selected or changed after consultation (see Section 17 "Contact", page 264).

By supplying reactive power, the inverter performs voltage-stabilizing measures in the event of overvoltage or undervoltage. The parameterization is carried out by means of a reactive power/voltage characteristic curve. The characteristic curve can be flexibly configured by parameterizing the slope, a type of deadband through two voltage points and a hysteresis.

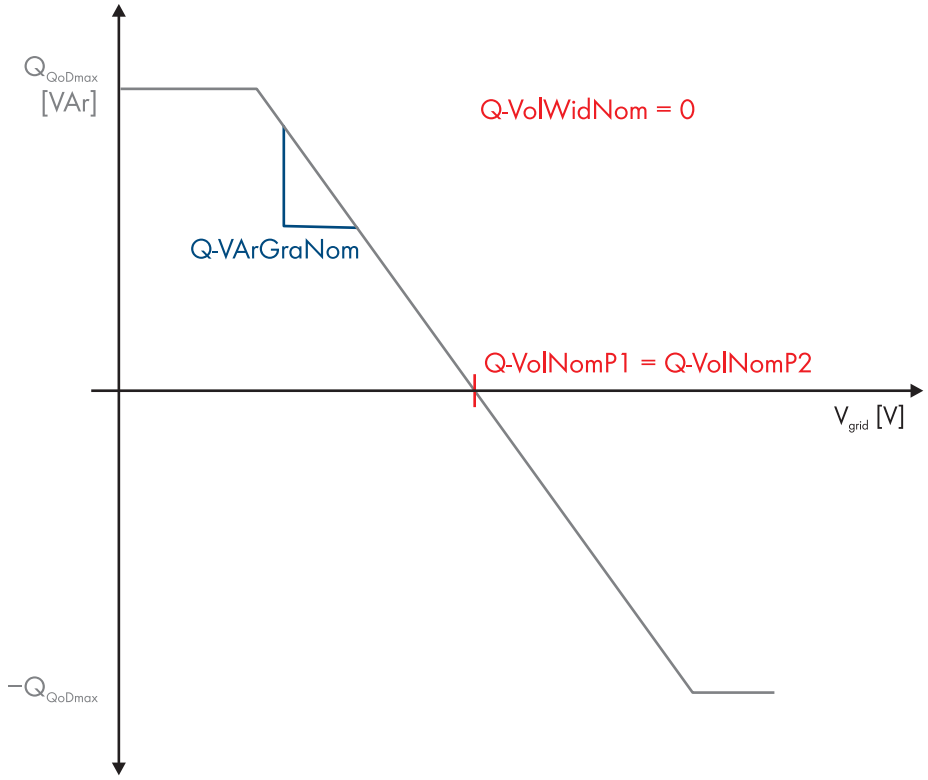


Figure 77: Characteristic curve for reducing reactive power without deadband and without hysteresis

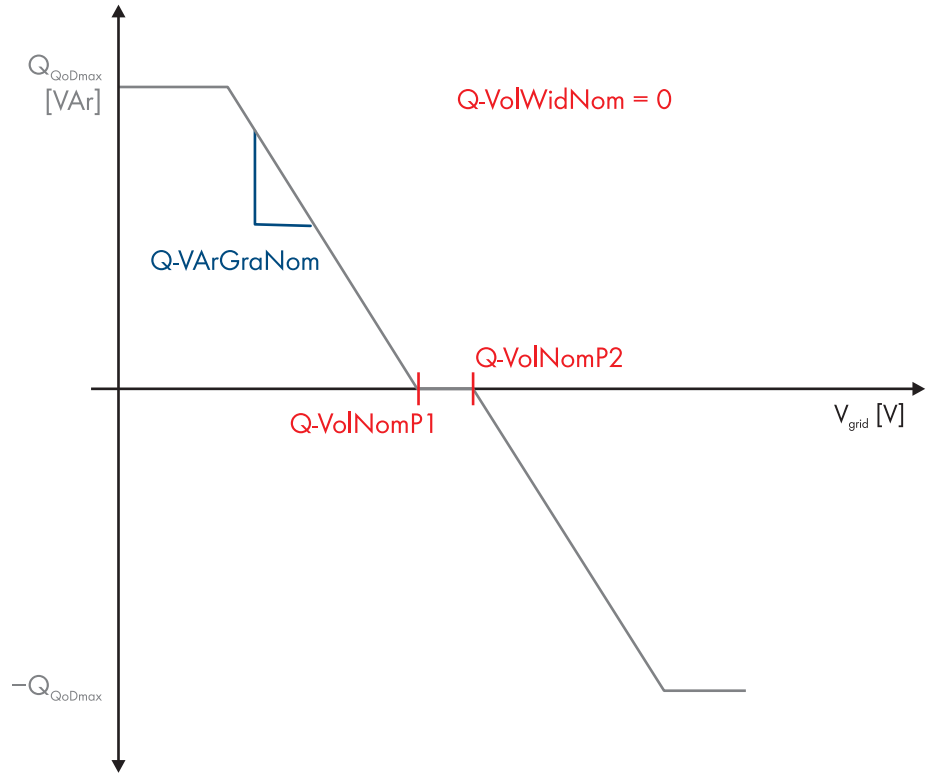


Figure 78: Characteristic curve for reducing reactive power with deadband

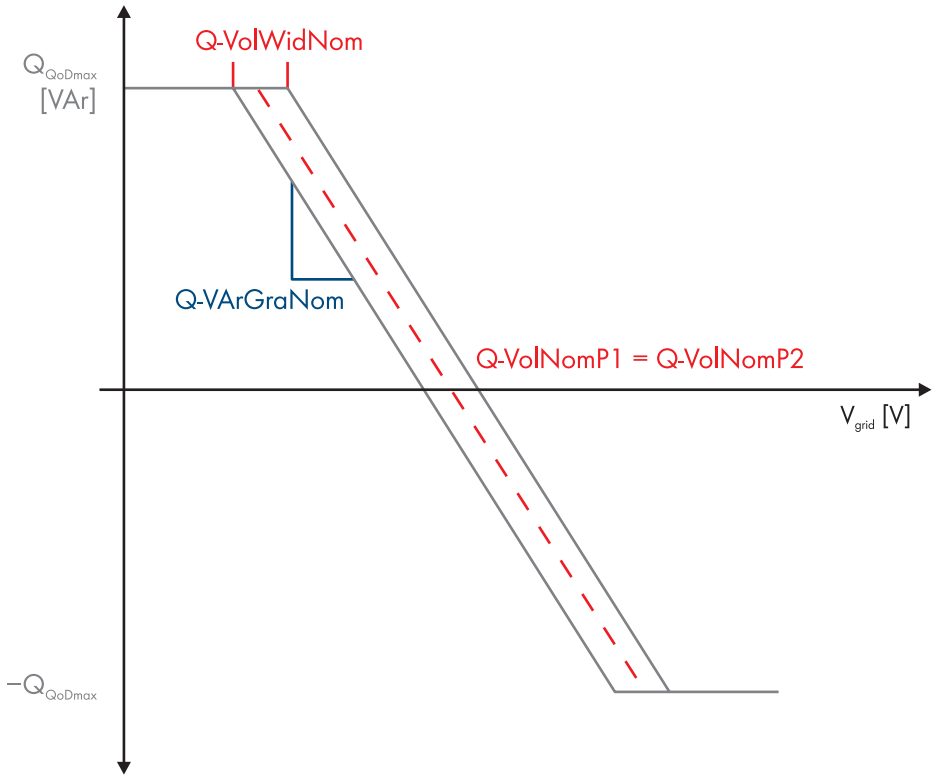


Figure 79: Characteristic curve for reducing reactive power with hysteresis

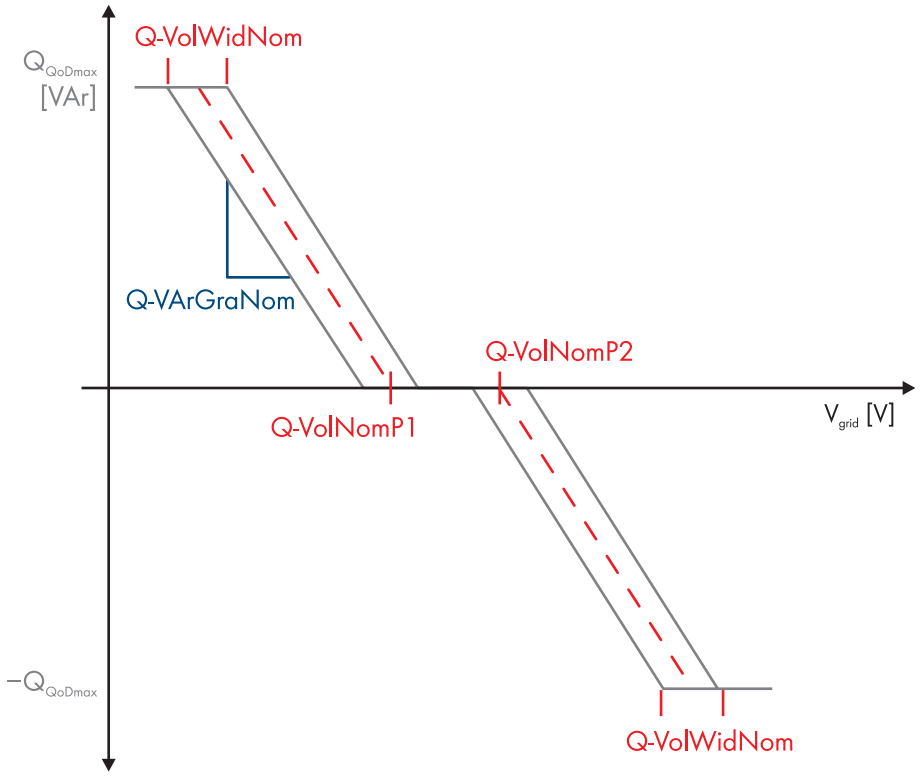


Figure 80: Characteristic curve for reducing reactive power with deadband and hysteresis

The parameter **Q-VArTmsSpnt** determines the delay time which must elapse before the calculated reactive power setpoint is actively used.

In order to prevent mutual interference of several systems with this function, the parameter **Q-VArTmsVtg** can be used to set a delay time. This delay time defines how long a voltage change must be pending before a change in reactive power feed-in is triggered. Consequently, control of the grid voltage at the grid feed-in point can be staggered across several systems.

You can activate and deactivate the delay time by means of the parameter **Q-EnaTmsVtg**.

13.3.4.8 Measures for Voltage Support through Parameterization of Reactive Power/ Voltage Characteristic Curve: VArCtlVolHystDbA Mode

Consultation prior to parameter change

The parameters of this mode can only be selected or changed after consultation (see Section 17 "Contact", page 264).

By supplying reactive power, the inverter performs voltage-stabilizing measures in the event of overvoltage or undervoltage. The parameterization is carried out by means of a reactive power/voltage characteristic curve. The characteristic curve can be configured flexibly by parameterization of the slopes, a type of deadband through two voltage points, a hysteresis and the thresholds for activation.

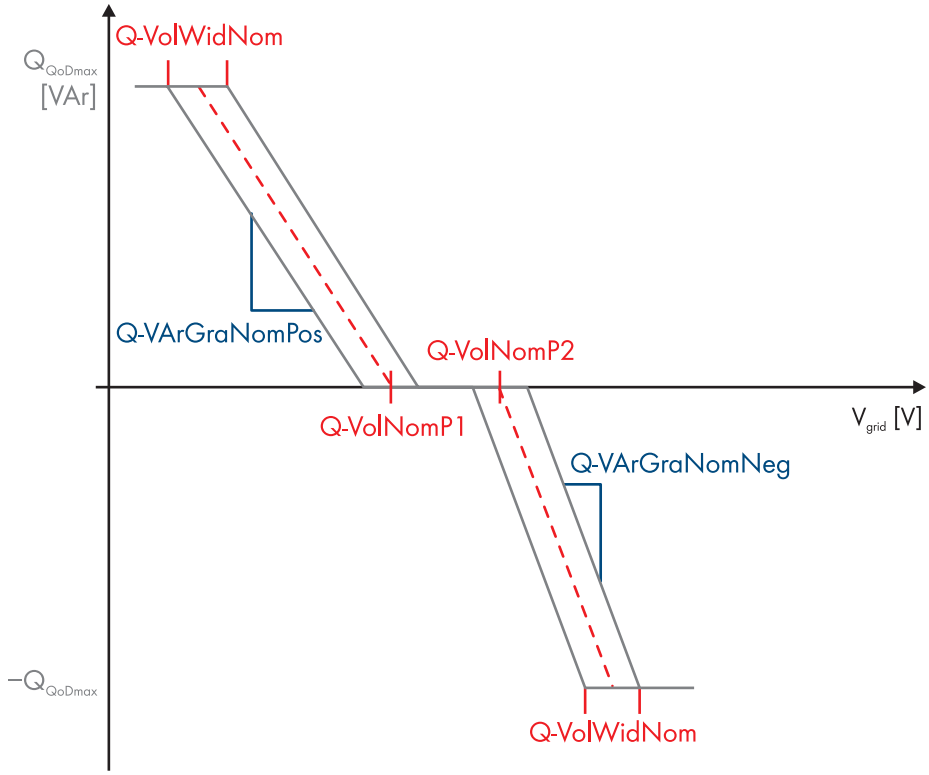


Figure 81: Characteristic curve for reducing reactive power with deadband and hysteresis

The parameter **Q-VArTmsSpnt** determines the delay time which must elapse before the calculated reactive power setpoint is actively used.

In order to prevent mutual interference of several systems with this function, the parameter **Q-VArTmsVtg** can be used to set a delay time. This delay time defines how long a voltage change must be pending before a change in reactive power feed-in is triggered. Consequently, control of the grid voltage at the grid feed-in point can be staggered across several systems.

You can activate and deactivate the delay time by means of the parameter **Q-EnaTmsVtg**.

In addition, the parameter **Q-VLockInW** can be used to define a voltage at which reactive power control will be activated after the time specified in parameter **Q-VLockInTm** has elapsed. If the voltage exceeds the threshold defined in parameter **Q-VLockOutW**, the reactive power control will be deactivated once the time specified in parameter **Q-VLockOutTm** has elapsed.

13.3.5 Behavior in the Absence of Active and Reactive Power Setpoints

In the event of failure of setpoints for active and reactive power control, the inverter is capable of bridging the gap in two ways:

- Use of last default values received:

  As long as the inverter does not receive any updated default values, it will use the last value received (when setpoint takes place via communication) and the last valid mean value (when using analog setpoints).

- Use of substitute values:

  As long as the inverter does not receive any updated default values, it will utilize the specified substitute values for active power limitation, reactive power setpoint and displacement power factor. In this case, different substitute values can be configured for feed-in operation and grid monitoring.

The parameter **PwrMonErrMod** is used to configure whether the last default values (**LastVal**) or the configured substitute values (**SubVal**) are to be used. This setting will be valid for both active and reactive power setpoints. The substitute values are used when the time since receiving the last valid signal for default values as defined in the parameter **PwrMonErrTm** has elapsed.

Setting	Description
LastVal	If specified via communication: utilization of the last value received In case of analog setpoints: utilization of the last valid mean value
SubVal	Use of configured substitute values The use of the substitute values is recommended when setpoints are effected via analog signals. • **P-WSubValRun**: substitute value for active power limitation in feed-in operation • **P-WSubVal**: substitute value for active power limitation outside of feed-in operation • **Q-VArSubValRun**: substitute value for the reactive power setpoint in feed-in operation • **PF-PFSubValRun**: substitute value for the displacement power factor in feed-in operation • **PF-PFExtSubValR**: substitute value for the excitation of the displacement power factor in feed-in operation • **Q-VArSubVal**: substitute value for the reactive power setpoint outside of feed-in operation • **PF-PFSubVal**: substitute value for the displacement power factor outside of feed-in operation • **PF-PFExtSubVal**: substitute value for the excitation of the displacement power factor outside of feed-in operation

13.4 Structure of the Communication Network

In order to connect the inverter to a computer via the service interface or via the Internet, the communication unit must be integrated in a system network. To enable several inverters to be operated in the same network, the communication unit of each inverter must be assigned a unique network address.

Depending on the order option, the inverter may be equipped with a managed switch.

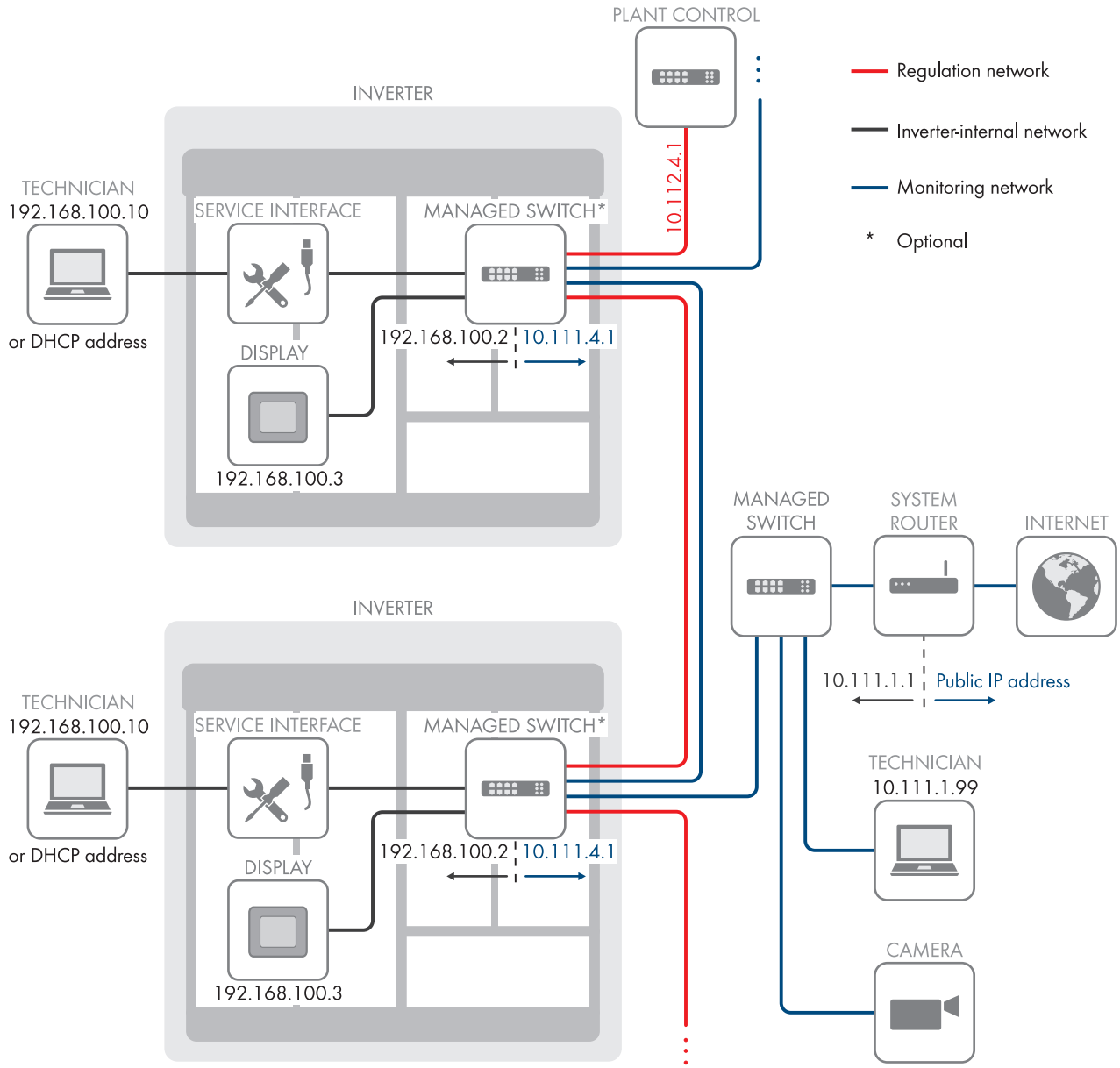


Figure 82: System network of two inverters (example)

Monitoring and control can be organized in two separate networks:

- **Monitoring network**

  This network is used for monitoring, parameterization and remote diagnosis.

- **Control network**

  The grid operator uses this network to transmit grid management specifications to the inverters. The control network is used exclusively for grid management services that need to be transmitted and implemented within a specified time period.

If only a low data transfer rate is required for monitoring, grid operator specifications can also be transmitted via the monitoring network. Only one network is required in this case.

13.5 Grid Management Services

13.5.1 Dynamic Grid Support (FRT)

13.5.1.1 Full and Limited Dynamic Grid Support (FRT)

With dynamic grid support (Fault Ride Through – FRT), the inverter supports the utility grid during a brief grid-voltage dip (Low Voltage Ride Through – LVRT) or during a short period of overvoltage (High Voltage Ride Through – HVRT).

With full dynamic grid support, grid support is ensured by feeding in reactive current.

With limited dynamic grid support, the inverter interrupts grid feed-in during a grid instability without disconnecting from the utility grid.

i Q at Night and dynamic grid support

Limited dynamic grid support is available in the operating state "Q at Night".

The dynamic grid support function is activated via the parameter **FRTEna**. The inverter behavior can be controlled via the parameter **FRTMod**. The level of reactive current provided with full dynamic grid support is determined via the parameter **FRTArGraNom**. The grid limits and deactivation delays vary depending on the country.

13.5.1.2 Grid Support in Case of Untervoltage (LVRT)

The inverter can support the utility grid during a brief grid-voltage dip. The behavior of the inverter depends on the percentage ratio of grid voltage V_{grid} to nominal voltage V.

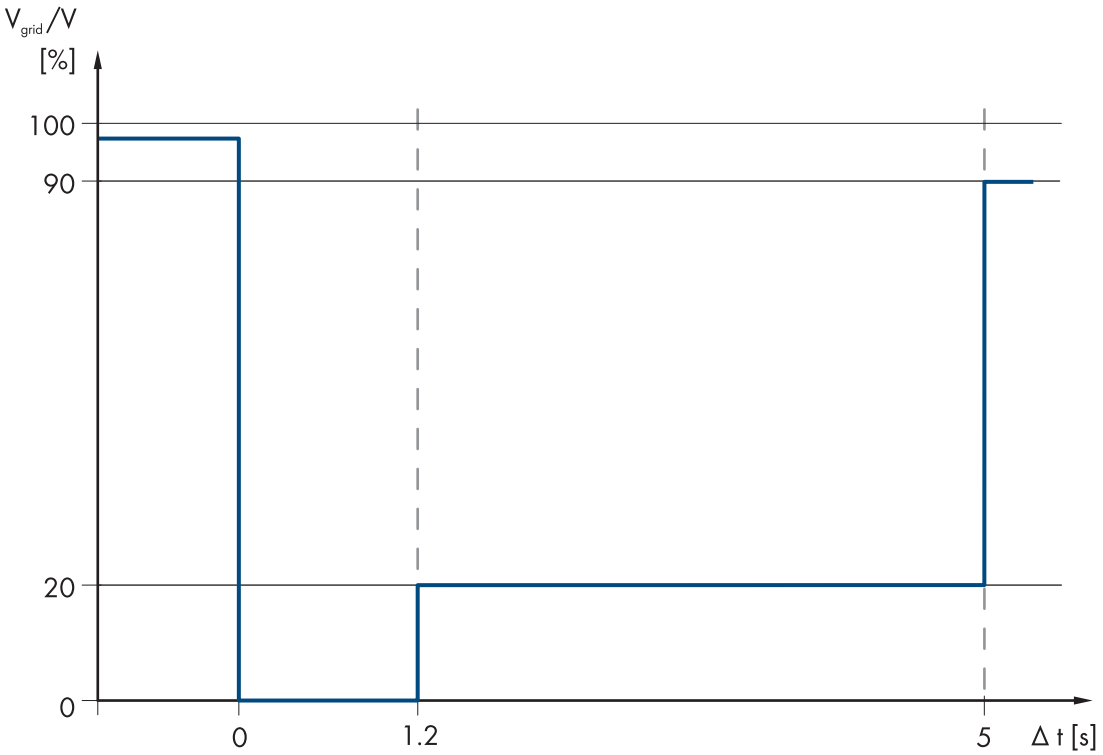


Figure 83: Maximum duration of a voltage dip that the inverter can work through without disconnecting from the utility grid

Ratio V_{grid}/V	Inverter behavior
90% to 100%	The ratio of grid voltage V_{grid} to nominal voltage V is in the normal range and the inverter feeds in without any problems.

Ratio V_{grid}/V	Inverter behavior
20% to 90%	The ratio of grid voltage V_{grid} to nominal voltage V is in the critical range. There is a disturbance in the utility grid. While this disturbance remains present, the inverter supports the utility grid with reactive current. The inverter can bridge disturbances of up to five seconds without disconnecting from the utility grid. If the set grid monitoring time is exceeded during this period, the inverter disconnects from the utility grid.
0% to 20%	The ratio of grid voltage V_{grid} to nominal voltage V is in the critical range. There is a disturbance in the utility grid. While this disturbance remains present, the inverter supports the utility grid with reactive current. The inverter can bridge disturbances of up to 1.2 seconds without disconnecting from the utility grid. The requirement is that the ratio V_{grid}/V was at least 90% before the error occurred. If the set grid monitoring time is exceeded during this period, the inverter disconnects from the utility grid.

The tripping threshold is defined by the parameter **FRTDbVolNomMin**.

13.5.1.3 Dynamic Undervoltage Detection

The dynamic undervoltage detection extends the grid support in the event of undervoltage and changes the switch-off behavior. The grid limits, which are stepped by default, are replaced by a continuous grid-limit function.

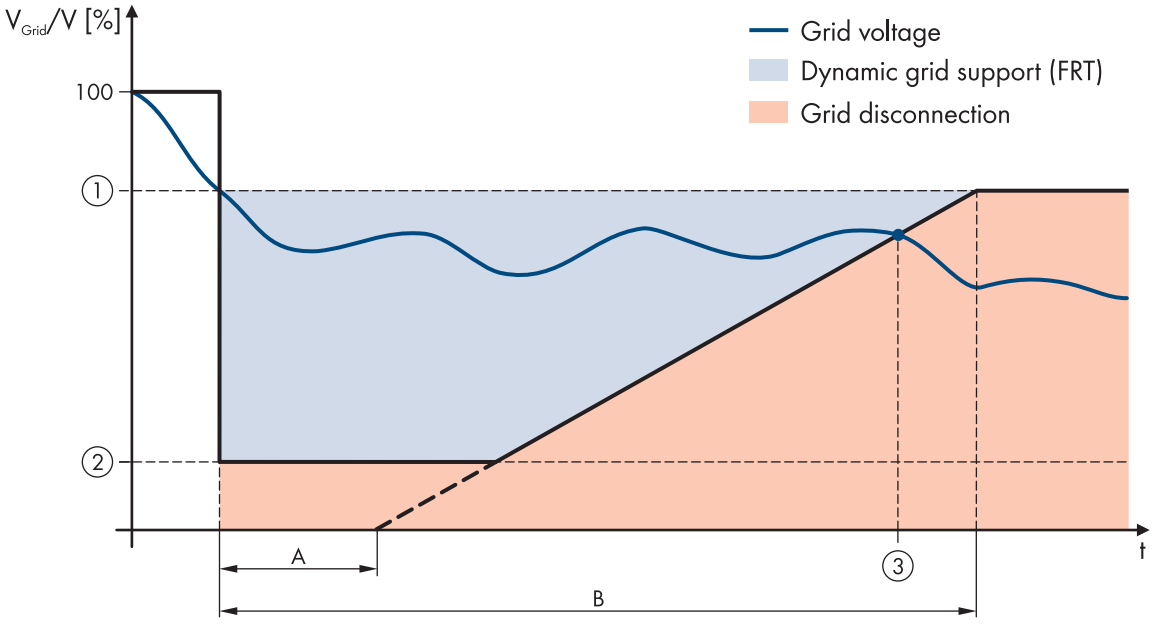


Figure 84: Maximum duration of a voltage dip that the inverter can work through without disconnecting from the utility grid

Position	Parameter	Description
1	VCtlILim	Grid voltage limit level 1
2	VCtlIILim	Grid voltage limit level 2
3	–	Time at which the inverter disconnects from the utility grid.

Position	Parameter	Description
A	VCtllCharTm	The delay time of the dynamic undervoltage detection defines the intersection of the continuous grid-limit function with the time axis.
B	VCtllLimTm	Delay time for grid limit level 1

The function of the dynamic undervoltage detection is activated via the parameter **VCtllCharEna**. The function of the dynamic undervoltage detection is activated by default for Romania.

13.5.1.4 Grid Support in the Event of Overvoltage (HVRT)

In addition to providing grid support in the event of undervoltage, the inverter can support the utility grid in the event of short-term overvoltage. The behavior of the inverter depends on the percentage ratio of grid voltage V_{grid} to nominal voltage V.

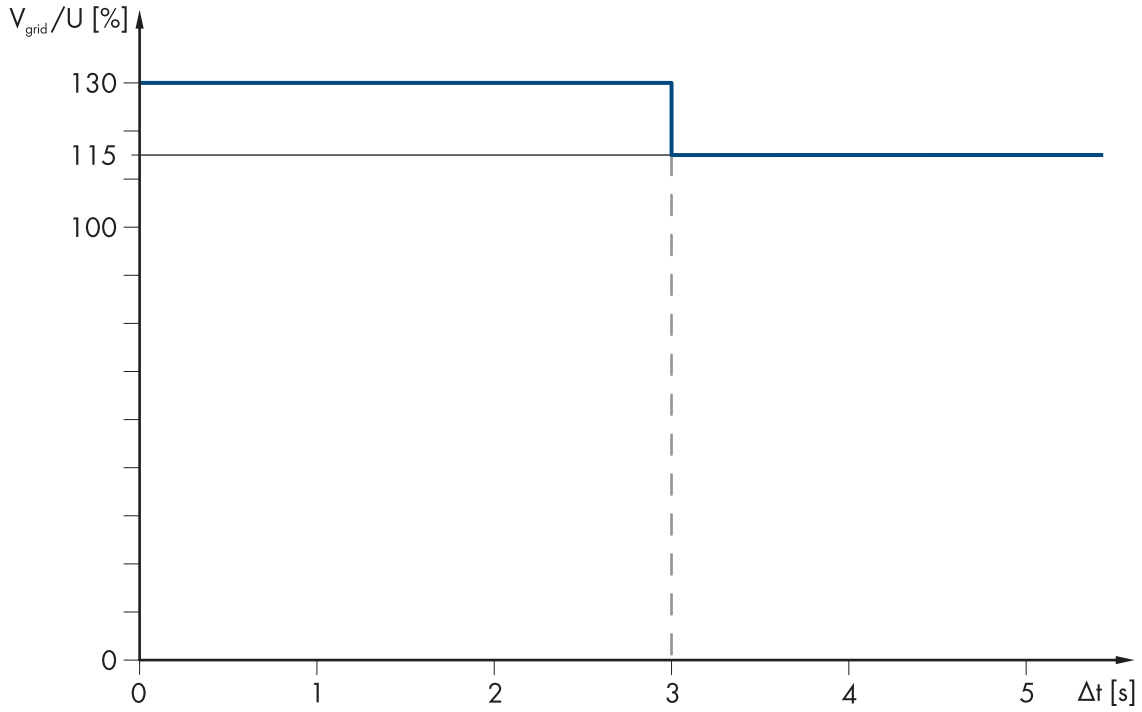


Figure 85: Maximum duration of overvoltage that the inverter can work through without disconnecting from the utility grid (example)

Ratio V_{grid}/V	Inverter behavior
Greater than 130%	The ratio of grid voltage V_{grid} to nominal voltage V is in the critical range. There is a disturbance in the utility grid. The inverter disconnects from the utility grid.
115% to 130%	The ratio of grid voltage V_{grid} to nominal voltage V is in the critical range. There is a disturbance in the utility grid. While this disturbance remains present, the inverter supports the utility grid with reactive current. The inverter can bridge disturbances of up to 3 seconds without disconnecting from the utility grid. If the set grid monitoring time is exceeded during this period, the inverter disconnects from the utility grid.
100% to 115%	The ratio of grid voltage V_{grid} to nominal voltage V is in the normal range and the inverter feeds in without any problems.

The tripping threshold is defined by the parameter **FRTDbVolNomMax**.

13.6 Cascade Control

The order option "Cascade control" allows for staggered reconnection of several medium-voltage switchgears after a grid failure or maintenance work. For this option, the following changes are implemented by default:

- The medium-voltage switchgear is motorized in the middle cable panel.
- The capacitive voltage detection system of the medium-voltage switchgear is equipped with an alarm contact.
- A control device is integrated in the medium-voltage compartment of the MV Power Station.

Up to four medium-voltage switchgears can be connected in this staggered manner. The crucial factors are the limited ampacity of the load-break switch in the cable panel and the sum of the high start-up currents of the MV transformers. This makes it possible to use an MV Power Station with cascade control to control four further MV Power Stations in an automated way.

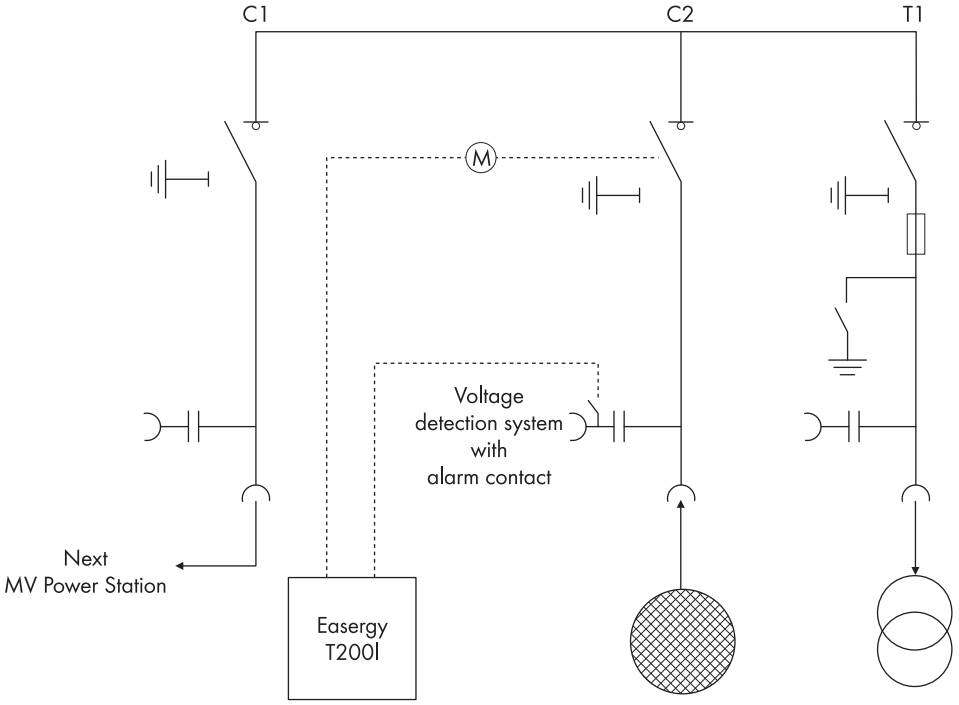


Figure 86: Simplified block circuit diagram of the medium-voltage switchgear with cascade control

The control device is connected to the middle cable panel of the medium-voltage switchgear and controls an integrated motor. Furthermore, the control device is connected to the alarm contact of the voltage detection system integrated in the medium-voltage switchgear. The alarm contact of the voltage detection system is used for connecting and disconnecting the middle cable panel. The switching limiting value for the voltage detection system is set in accordance with IEC 61 243-5. The voltage is measured upstream the load-break switch in the middle cable panel.

If the voltage falls below the permitted switching limit, a signal is transmitted to the control device and the middle cable panel of the controlled medium-voltage switchgear is disconnected with a delay of three seconds. If the voltage detection system measures a voltage exceeding the permitted switching limit, a signal is transmitted to the control device and the middle cable panels of the connected medium-voltage switchgears are connected gradually. The time delay for gradual connection must be set in accordance with the grid operator's specifications. The time delay is set to ten seconds by default.

The control device is monitored and configured via the serial RS232 interface, a USB port and the Ethernet network by means of a web-based user interface (for operating information, refer to the documentation of the control device). Laying the communication cables is within the responsibility of the customer.

The Easergy T200I from Schneider Electric is used as control device.

13.7 Grid Protection

The order option "Grid protection" allows for voltage and frequency monitoring of the utility grid and disconnection of the inverter after a grid fault. This order option is independent of the grid monitoring function integrated in the inverter.

For this purpose, a voltage and frequency monitoring relay is installed in the subdistribution of the MV Power Station. The relay is connected to the transformer for internal power supply and measures the power frequency and the grid voltage on the low-voltage side of the system.

If the measured values for grid voltage and power frequency exceed the set grid limits, the relay disconnects the inverter via the fast stop input. The grid limits are set in accordance with the "Engineering Recommendation G59/2" by default (for information on changing the configuration, see the documentation of the voltage and frequency monitoring relay).

The VMD460-NA from Bender GmbH & Co. KG is used as voltage and frequency monitoring relay.

13.8 Low-Voltage Meter

The order option "Low-voltage meter" allows for recording of the inverter feed-in power and recording of the power consumption of the entire MV Power Station. For this reason, up to three low-voltage meters are installed in the station subdistribution. The low-voltage meters measure the values by using the voltage converters and current transformers.

Low-voltage meter for	Required transducers
Measuring the feed-in power of the inverters	Two current transformers and two voltage converters are installed for each inverter. The transformers and converters are connected to busbars of the corresponding inverter (for information on wiring, refer to the circuit diagram).
Measuring the self-consumption of the MV Power Station	Four current transformers with voltage tap are installed. The transformers and converters are connected in the station subdistribution downstream the main switch (for information on wiring, refer to the circuit diagram).

Each low-voltage meter communicates via the serial RS485 interface and Ethernet (for operating information, refer to the documentation of the low-voltage meter). Laying the communication cables is within the responsibility of the customer.

The UMG 604E from Janitza electronics GmbH is used as low-voltage meter.

13.9 Zone Monitoring

The order option "Zone Monitoring" offers the possibility to monitor up to eight input currents of the inverter as standard, to detect fuse and string failures, and in this way, to minimize the power and yield losses.

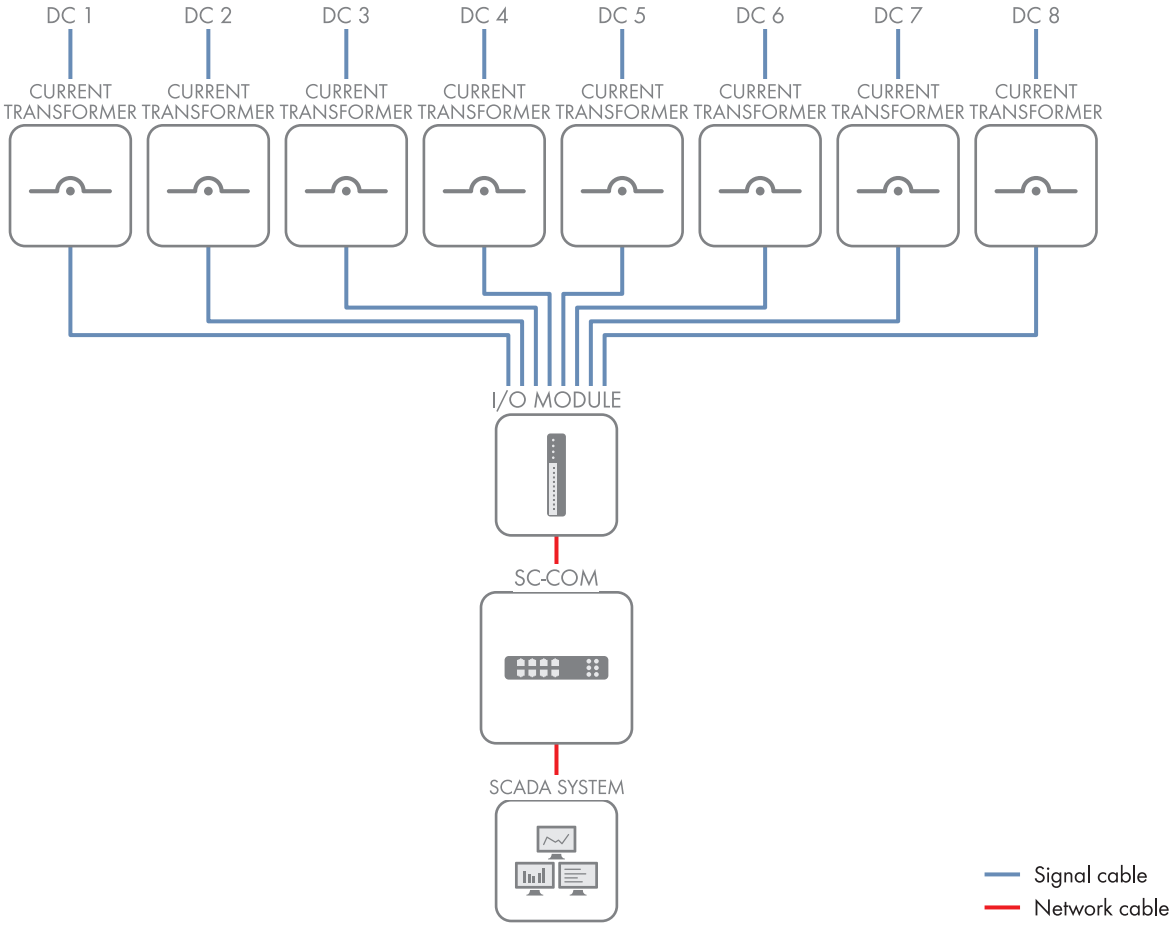


Figure 87: Function principle "Zone Monitoring"

The input currents are monitored by the current transformers installed on the DC rails. The current transformers measure the input currents and forward the measured values via I/O interface to the communication unit. The communication unit continually calculates the mean values of the input currents and compares the current measured values with the mean values. If an input current falls below the mean value by a user-defined tolerance, the communication unit issues a message. For correct analysis of the input currents, the following must be set:

- Maximum input current for each input
- Tolerance in percent by which the input current may deviate from the mean value

When a deviation occurs, the error message is displayed in the event report, if the error analysis is activated. It can also be sent to Sunny Portal or, depending on the settings, it can be forwarded by e-mail.

14 Operating Data and Parameters

The information in the following sections affect the inverters only. Information on the operating data and parameters of further optional devices of the MV Power Station, such as the medium-voltage switchgear or the control device for cascade control, can be found in the documentation of the respective device.

14.1 Operating Data

14.1.1 Inverter

14.1.1.1 Power Limitation

Errors and warnings relating to active power limitation

Name	Display	Description
P-WModFailStt	Off	No mode for active power limitation has been selected.
	Ok	A mode for active power limitation has been selected and no error is present.
	ComFail	The mode **WCtlCom** has been selected and the expected signal with a valid active power limitation has been absent for at least five minutes.
	AnInFail	The mode **WCnstNomAnIn** has been selected and the value measured at the analog input is less than 2 mA.
	ComInvalid	The mode **WCtlCom** has been selected and there is invalid content in the power setpoint information.

Status messages of active power limitation

Name	Display	Description
P-WModStt	Off	No mode for active power limitation has been selected.
	WMax	Active power is limited by specification of an upper limit. This limit is based on **Pmax**.
	Hz	Active power is limited by a frequency increase.
	Tmp	Active power is limited by temperature derating.
	AmpPv	Active power is limited via a PV current limitation.
	AmpAC	Active power is limited via an AC current limitation.
	SMax	The active power is limited by the maximum apparent power.
	Q-VAr	The active power is limited due to the priority of the reactive power setpoint.
	QEnsure	The active power is limited due to the intermediate storage of reactive power.
	P-Vtg	The active power is limited due to the characteristic curve P(V).
	VdcMax	The active power is increased via the setpoint due to the DC voltage being too high.
	AmpPvOptiprot	For the order option "Optiprotect", the active power is limited due to switch currents being too high.

Errors and warnings relating to the reactive power setpoint

Name	Display	Description
Q-VArModFailStt	Off	No mode for specifying the reactive power setpoint has been selected.
	Ok	A mode for specifying the reactive power setpoint has been selected and no error is present.
	ComFail	The mode **VArCtlCom** or **PFCtlCom** has been selected and the expected signal with a valid reactive power setpoint has been absent for at least five minutes.
	AnInFail	The mode **VArCnstNomAnIn** or **PFCnstAnIn** has been selected and the value measured at the analog input is less than 2 mA.
	ComInvalid	The mode **VArCtlCom** or **PFCtlCom** has been selected and there is invalid content in the power setpoint information.

Status messages of the reactive power setpoint

Name	Display	Description
Q-VArModStt	Off	No mode for specifying the reactive power setpoint has been selected.
	VdcMax	The reactive power is limited due to DC voltage being too high.
	VacLimMax	The reactive power is limited due to AC voltage being too high.
	VacLimMin	The reactive power is limited due to the AC voltage being too low.
	SMaxVdcHigh	The maximum apparent power value is reduced. If the maximum DC voltage increases, the reactive power is reduced.
	SMax	The reactive power is limited by the maximum apparent power.
	Tmp	The reactive power is limited by temperature derating.
	AmpAC	The reactive power is limited via an AC current limitation.
	P	The reactive power is limited due to the priority of the active power setpoint.
	FrtLim	The reactive power is limited due to the FRT voltage limit.

Displacement power factor and power setpoint

Name	Display	Description
PF	–	Current displacement power factor cos φ
PFExt	OvExt	Overexcited
	UnExt	Underexcited
P-WSpt	–	Current power specification

14.1.1.2 Error Channels

Name	Description
Prio	Priority of error message
Msg	Error message
Dsc	Measure for error correction
TmsRmg	Time until reconnection
GriSwStt	Status of the AC contactor
Mode	Operating state of the inverter
Error	Localization of the error
ErrNo	Error number
ErrNoFirst	Error number of the first error

14.1.1.3 Measured Values

Name	Description
Vac	Grid voltage in V
Iac	Grid current in A
Pac	AC power in kW
Qac	Reactive power in kVAr
Sac	Apparent power in kVA
Fac	Power frequency in Hz
Vpv	PV voltage in V
Ipv	PV current in A
Ppv	PV power in kW
ExlAnaInCur1	External current measurement in mA
ExlAnaInV1	External voltage measurement in V
Riso	Insulation resistance

14.1.1.4 Internal Device Values

Name	Description
DInExlStrStp	Status of the remote shutdown unit
DInKeySwStrStp	Status of key switch
DInGfdi	Status of GFDI
DOutMntSvc	State of the signal light
Firmware	Firmware version of operation control unit
Firmware-2	Firmware version of digital signal processor
Cntry	Country setting or configured standard
Dt	Datum
Tm	Time
Type	Device type

14.1.1.5 Internal Meters

Name	Description
h-On	Operating hours (feed-in time and waiting time) of the inverter, in h
h-Total	Feed-in hours (feed-in time without waiting time) of the inverter, in h
E-Total	Total energy fed into the grid, in kWh
E-Today	Energy fed in during the current day, in kWh

Name	Description
CntFanHs	Operating hours of the heat sink fan, in h
CntFanCab1	Operating hours of the interior fan 1, in h
CntFanCab2	Operating hours of the interior fan 2, in h
CntFanCab3	Operating hours of the interior fan 3, in h
CntHtCab2	Operating hours of the heating element 2, in h
CntGfdiSw	Number of GFDI trippings
h-HighV	Operating hours at high DC voltage

14.1.1.6 Service-Relevant Displays

The following table lists display values containing service information.

Name		
BfrSollrr	CardStt	ExtSollrr
Fb_SVMMode	FeedInStt	Firmware-3
Firmware-4	Firmware-5	Firmware-6
Firmware-7	Firmware-8	Firmware-9
Firmware-CRC	Firmware-2-CRC	Firmware-5-CRC
Firmware-6-CRC	GriSwStt	InfFlgs
LvrtVtgNom	ManResStt	Mode
ParaSetStt	StkErrFirst	StkErrFlgs
SvmMode		

14.1.2 Sunny Central String-Monitor Controller

14.1.2.1 Instantaneous Values

Name	Description
MeanCurGr1	Mean current for group 1; mean value exists for all six groups
SSMUWrnCode	String-failure detection
SSMUNoOf	Number of Sunny String-Monitors found

14.1.2.2 Internal Device Values

Name	Description
h-On	Operating hours of the Sunny Central String-Monitor Controller
SysDt	System date
SysTm	System time

14.1.2.3 Status Values

Name	Description
Error	Error detected by the Sunny Central String-Monitor Controller
Mode	Operating state of the Sunny Central String-Monitor Controller
ParaCfg	Error in parameterization of monitoring time detected
SSMUWrnTxt	Warning message

14.1.3 Sunny String-Monitor

14.1.3.1 Instantaneous Values

Name	Description
IString 1	Mean value of the current of string 1 over the last 30 seconds; mean value exists for all eight measuring channels

14.1.3.2 Internal Device Values

Name	Description
Meldekontakt 1	Status of alarm contact 1
Meldekontakt 2	Status of alarm contact 2
Netz-Adresse	Network address of the Sunny String-Monitor
Seriennummer	Serial number of the Sunny String-Monitor

14.1.3.3 Status Values

Name	Description
Fehler	Error detected by the Sunny String-Monitor
Status	Operating status of the Sunny String-Monitor

14.1.4 Zone Monitoring

14.1.4.1 Instantaneous Values

Name	Description
DcMs.Amp[x]	DC current at input x
ActTol[x]	Deviation of maximum standardized current in percent at input x

14.1.4.2 Status Values

Name	Values	Description
Mode	–	Initialization
	Waiting	Zone Monitoring is activated, but the minimum current for the evaluation is not yet reached.
	Operation	Zone Monitoring is activated and the minimum current for the evaluation is reached.
	Disturbance	Disturbance
	Error	Error
Error	–	There is no warning, disturbance or error to display.
	ConfigFail	Current inputs are not configured. At least two inputs have to be configured.
	ZoneValueLow	At least one input has an input current which is too low.
	ZoneValueFail	For at least one input, the input current is no longer measured (input current ≤ 2 A)
	CalibrationFail	Calibration has failed.
	DevNotReachable	I/O module has not answered for at least 30 seconds.
StatusZone[x]	–	No error
	ZoneValueLow	The input has an input current which is too low.
	ZoneValueFail	For the input, the input current is no longer measured (input current ≤ 2 A).

14.2 Parameters

14.2.1 Inverter

14.2.1.1 Power Limitation

Name	Description	Value/range	Explanation	Default value
Plimit*	Limitation of the nominal device power including apparent power	0 kW to 550 kW	Sunny Central 500CP XT	550 kW
		0 kW to 700 kW	Sunny Central 630CP XT	700 kW
		0 kW to 792 kW	Sunny Central 720CP XT	792 kW
		0 kW to 836 kW	Sunny Central 760CP XT	836 kW
		0 kW to 880 kW	Sunny Central 800CP XT	880 kW
		0 kW to 935 kW	Sunny Central 850CP XT	935 kW
		0 kW to 990 kW	Sunny Central 900CP XT	990 kW
		0 kW to 1,100 kW	Sunny Central 1000CP XT	1,100 kW

Name	Description	Value/range	Explanation	Default value
Pmax**	Limitation of the nominal power	0 kW to 550 kW	Sunny Central 500CP XT	550 kW
		0 kW to 700 kW	Sunny Central 630CP XT	700 kW
		0 kW to 792 kW	Sunny Central 720CP XT	792 kW
		0 kW to 836 kW	Sunny Central 760CP XT	836 kW
		0 kW to 880 kW	Sunny Central 800CP XT	880 kW
		0 kW to 935 kW	Sunny Central 850CP XT	935 kW
		0 kW to 990 kW	Sunny Central 900CP XT	990 kW
		0 kW to 1,100 kW	Sunny Central 1000CP XT	1,100 kW
P-WMod**	Mode for active power limitation	Off	Limits active power to **Pmax**	Off
		WCtlCom	Limits active power via an external control unit, such as the Power Reducer Box	
		WCnst	Manually limits active power in kW (**P-W**) via communication devices, such as the SC-COM	
		WCnstNom	Manually limits active power in % (**P-WNom**) via communication devices, such as the SC-COM	
		WCnstNomAnIn	Limits active power in % at the analog input	
		WCnstNomDigIn	Limits active power at the digital input. This mode is not supported.	
P-W	Active power limit in kW The active power cannot exceed **Pmax**.	0 kW to 1,000 kW	Sunny Central 500CP XT	550 kW
		0 kW to 1,000 kW	Sunny Central 630CP XT	700 kW
		0 kW to 1,000 kW	Sunny Central 720CP XT	792 kW
		0 kW to 1,000 kW	Sunny Central 760CP XT	836 kW
		0 kW to 1,000 kW	Sunny Central 800CP XT	880 kW
		0 kW to 1,000 kW	Sunny Central 850CP XT	935 kW
		0 kW to 1,000 kW	Sunny Central 900CP XT	990 kW
		0 kW to 1,100 kW	Sunny Central 1000CP XT	1,100 kW
P-WNom	Limitation of active power in %	0 % ... 100 %	–	100 %

Name	Description	Value/range	Explanation	Default value
WCtlHzMod**	Activation of frequency-dependent active power limitation	Off	Deactivated	Country-specific
		CurveHys	Procedure with hysteresis	
		Curve	Procedure without hysteresis	
P-HzStr**	Starting point of frequency control	Country-specific	–	Country-specific
P-HzStop**	End point of frequency control	Country-specific	–	Country-specific
P-HzStopMin**	Minimum frequency at end point of frequency control	Country-specific	–	Country-specific
P-WGra**	Gradient of active power limitation in case of active power limitation dependent on the frequency	1%/Hz to 100%/Hz	–	Country-specific
Qlimit*	Reactive power of device	0 kVAr to 245 kVAr	Sunny Central 500CP XT	245 kVAr
		0 kVAr to 310 kVAr	Sunny Central 630CP XT	310 kVAr
		0 kVAr to 346 kVAr	Sunny Central 720CP XT	346 kVAr
		0 kVAr to 365 kVAr	Sunny Central 760CP XT	365 kVAr
		0 kVAr to 385 kVAr	Sunny Central 800CP XT	385 kVAr
		0 kVAr to 409 kVAr	Sunny Central 850CP XT	409 kVAr
		0 kVAr to 433 kVAr	Sunny Central 900CP XT	433 kVAr
		0 kVAr to 485 kVAr	Sunny Central 1000CP XT	485 kVAr
Qmax**	Limitation of reactive power	0 kVAr to 245 kVAr	Sunny Central 500CP XT	245 kVAr
		0 kVAr to 310 kVAr	Sunny Central 630CP XT	310 kVAr
		0 kVAr to 346 kVAr	Sunny Central 720CP XT	346 kVAr
		0 kVAr to 365 kVAr	Sunny Central 760CP XT	365 kVAr
		0 kVAr to 385 kVAr	Sunny Central 800CP XT	385 kVAr
		0 kVAr to 409 kVAr	Sunny Central 850CP XT	409 kVAr
		0 kVAr to 433 kVAr	Sunny Central 900CP XT	433 kVAr
		0 kVAr to 485 kVAr	Sunny Central 1000CP XT	485 kVAr

Name	Description	Value/range	Explanation	Default value
QoDQmax*	Limitation of reactive power in the operating state "Q at Night". The reactive power cannot exceed **Qlimit**.	0 kVAr to 245 kVAr	Sunny Central 500CP XT	245 kVAr
		0 kVAr to 310 kVAr	Sunny Central 630CP XT	310 kVAr
		0 kVAr to 346 kVAr	Sunny Central 720CP XT	346 kVAr
		0 kVAr to 365 kVAr	Sunny Central 760CP XT	365 kVAr
		0 kVAr to 385 kVAr	Sunny Central 800CP XT	385 kVAr
		0 kVAr to 409 kVAr	Sunny Central 850CP XT	409 kVAr
		0 kVAr to 433 kVAr	Sunny Central 900CP XT	433 kVAr
		0 kVAr to 485 kVAr	Sunny Central 1000CP XT	485 kVAr
QEnsure*	Guaranteed reactive power	0 kVAr to 245 kVAr	Sunny Central 500CP XT	0 kVAr
		0 kVAr to 310 kVAr	Sunny Central 630CP XT	
		0 kVAr to 346 kVAr	Sunny Central 720CP XT	
		0 kVAr to 365 kVAr	Sunny Central 760CP XT	
		0 kVAr to 385 kVAr	Sunny Central 800CP XT	
		0 kVAr to 409 kVAr	Sunny Central 850CP XT	
		0 kVAr to 433 kVAr	Sunny Central 900CP XT	
		0 kVAr to 485 kVAr	Sunny Central 1000CP XT	
PFAbsMin*	Limitation of the displacement power factor cos φ	0.5 ... 1	–	0.9

Name	Description	Value/range	Explanation	Default value
Q-VArMod**	Mode for reactive power control	Off	Sets reactive power to 0 kVAr and displacement power factor cos φ to 1	Off
		VArCtlCom	Specifies reactive power via external control unit, such as the Power Reducer Box	
		PFCtlCom	Specifies the displacement power factor cos φ and the excitation of the displacement power factor via an external control unit such as the Power Reducer Box	
		VArCnst	Specifies reactive power in kVAr via the parameter **Q-VAr**	
		VArCnstNom	Specifies reactive power in % via the parameter **Q-VArNom**	
		VArCnstNomAnIn	The reactive power setpoint is imported via an analog input.	
		PFCnst	Manual specification of the displacement power factor cos φ and excitation of the displacement power factor via the parameters **PF-PF** and **PF-PFExt**.	
		PFCnstAnIn	Specifies the displacement power factor cos φ at the analog input **QExlSpnt** via control unit	
		PFCtlW	Specifies the displacement power factor cos φ depending on the feed-in power	
		VArCtlVol	Specifies reactive power as a function of the grid voltage	
		VArCtlVolHystDb	Specifies reactive power as a function of the grid voltage (Q = f(V) characteristic curve)	
		VArCtlVolHysDbA	Specifies reactive power as a function of the grid voltage with activation power (for Italy)	

Name	Description	Value/range	Explanation	Default value
QoDQ-VArMod**	Reactive power setpoint in the operating mode "Q at Night"	Off	Sets reactive power to 0 kVAr and displacement power factor cos φ to 1	Off
		VArCtlCom	Specifies reactive power via external control unit, such as the Power Reducer Box	
		VArCnst	Specifies reactive power in kVAr via the parameter **QoDQ-VAr**	
		VArCnstNom	Specifies reactive power in % via the parameter **QoDQ-VArNom**	
		VArCnstNomAnIn	The reactive power setpoint is imported via an analog input.	
		VArCtlVol	Specifies reactive power as a function of the grid voltage	
		VArCtlVolHystDb	Specifies reactive power as a function of the grid voltage (Q = f(V) characteristic curve)	
Q-VAr	Reactive power in kVAr	−245 kVAr to +245 kVAr	Sunny Central 500CP XT	0 kVAr
		−310 kVAr to +310 kVAr	Sunny Central 630CP XT	
		−346 kVAr to +346 kVAr	Sunny Central 720CP XT	
		−365 kVAr to +365 kVAr	Sunny Central 760CP XT	
		−385 kVAr to +385 kVAr	Sunny Central 800CP XT	
		−409 kVAr to +409 kVAr	Sunny Central 850CP XT	
		−433 kVAr to +433 kVAr	Sunny Central 900CP XT	
		−485 kVAr to +485 kVAr	Sunny Central 1000CP XT	

Name	Description	Value/range	Explanation	Default value
QoDQ-Var**	Reactive power setpoint in the operating mode "Q at Night"	−245 kVAr to +245 kVAr	Sunny Central 500CP XT	0 kVAr
		−310 kVAr to +310 kVAr	Sunny Central 630CP XT	
		−346 kVAr to +346 kVAr	Sunny Central 720CP XT	
		−365 kVAr to +365 kVAr	Sunny Central 760CP XT	
		−385 kVAr to +385 kVAr	Sunny Central 800CP XT	
		−409 kVAr to +409 kVAr	Sunny Central 850CP XT	
		−433 kVAr to +433 kVAr	Sunny Central 900CP XT	
		−485 kVAr to +485 kVAr	Sunny Central 1000CP XT	
Q-VArNom	Reactive power in %	−100 % ... +100 %	–	0 %
QoDQ-VArNom	Reactive power in % in the operating state "Q at Night"	−100 % ... +100 %	–	0 %
PF-PF	Displacement power factor cos φ The lower limit is defined by the parameter **PFAbsMin**.	0.5 ... 1	–	1
PF-PFExt	Excitation of the displacement power factor cos φ	OvExt	Overexcited	OvExt
		UnExt	Underexcited	
PF-PFStr**	Displacement power factor cos φ at characteristic curve point 1 The lower limit is defined by the parameter **PFAbsMin**.	0.5 ... 1	–	0.9
PF-PFExtStr**	Excitation of the displacement power factor cos φ at characteristic curve point 1	OvExt	Overexcited	OvExt
		UnExt	Underexcited	

Name	Description	Value/range	Explanation	Default value
PF-PFStop**	Displacement power factor cos φ at characteristic curve point 2 The lower limit is defined by the parameter **PFAbsMin**.	0.5 ... 1	–	0.9
PF-PFExtStop**	Excitation of the displacement power factor cos φ at characteristic curve point 2	OvExt	Overexcited	OvExt
		UnExt	Underexcited	
PF-WStr**	Feed-in power in % at characteristic curve point 1	0 % ... 90 %	–	0 %
PF-WStop**	Feed-in power in % at characteristic curve point 2	10 % ... 100 %	–	100 %
PF-WLockInVtg**	Activation voltage of the cos φ(P) characteristic curve, in %, relative to the nominal voltage	0 % ... 110 %	–	0 %
PF-WLockOutVtg**	Deactivation voltage of the cos φ(P) characteristic curve, in %, relative to the nominal voltage	0 % ... 110 %	–	0 %
PF-WLockTm	Waiting time for activation or deactivation of the cos φ(P) characteristic curve	0 s to 100 s	–	2 s
Q-VDif**	Definition of voltage variation leading to a change in reactive power	0.1 % ... 10 %	The value refers to the nominal voltage **VRtg**.	1 %
Q-VArGra**	Definition of the reactive power setpoint change in one voltage step	0 % ... 100 %	The value refers to the nominal power **Pmax**.	1 %
Q-VDifTm**	Time period for which a voltage change must be present before the reactive power setpoint **Q-VArGra** changes.	0 s to 120 s	–	1 s

Name	Description	Value/range	Explanation	Default value
Q-VRtgOfsNom**	Nominal voltage **VRtg** of the voltage-dependent reactive power control This parameter is only active if the parameter **Q-VArMod** is set to **VArCtlCol**.	−10 % ... +10 %	–	0 %
Q-VArGraNom**	Reactive power gradient	0%/V to 40.06%/V	Sunny Central 500CP XT	0%/V
		0%/V to 31.47%/V	Sunny Central 630CP XT	
		0%/V to 27.82%/V	Sunny Central 720CP XT	
		0%/V to 26.35%/V	Sunny Central 760CP XT	
		0%/V to 25.04%/V	Sunny Central 800CP XT	
		0%/V to 23.56%/V	Sunny Central 850CP XT	
		0%/V to 22.25%/V	Sunny Central 900CP XT	
		0%/V to 22.25%/V	Sunny Central 1000CP XT	
Q-VolWidNom**	Voltage range	0 % ... 20 %	–	0 %
Q-VolNomP1**	Voltage at point 1	80 % ... 120 %	–	100 %
Q-VolNomP2**	Voltage at point 2	80 % ... 120 %	–	100 %
Q-VArTmsSpnt**	Time setting of the characteristic curve point	0.2 s to 20 s	–	10 s
Q-VArTmsVtg**	Connection delay of the grid voltage	0.2 s to 20 s	–	10 s
Q-EnaTmsVtg**	Activation of the connection delay of the grid voltage	Off	Deactivated	Off
		On	Activated	
WGra**	Gradient of the active power change for setpoint of active power limitation	0.017%/s to 100%/s	–	Country-specific
WGraEna**	Activation of the active power change gradient	Off	Deactivated	On
		On	Activated	
WGraRecon**	Gradient of active power change for reconnection	0.017%/s to 100%/s	–	Country-specific

Name	Description	Value/range	Explanation	Default value
WGraReconEna**	Activation of the decoupling protection ramp for reconnection	Off	Deactivated	Country-specific
		On	Activated	
P-VtgGraNom**	Active power gradient for voltage-dependent active power limitation	0.017%/s to 100.000%/s	–	0.166%/s
P-VtgEna	Activation of voltage-dependent active power limitation	Off	Deactivated	Off
		On	Activated	
P-VtgNomP1	Voltage at point 1	100 % ... 120 %	–	111%
P-VtgNomP2	Voltage at point 2	90 % ... 120 %	–	110 %
P-VtgAtMin	Minimum active power with voltage-dependent active power limitation	0 % ... 100 %	–	20 %
PwrApLimitPrio***	Prioritization of reactive power or active power	PrioPwrRtPrioPwrRt	Prioritization of reactive power	PrioPwrRtPrioPwrRt
		PrioPwrAt	Prioritization of active power	
SDLimComSrc***	Selection of the SDLimit source	CAN	Interface of the communication unit	UART
		UART	Via SMA Net	
P-WSubVal	Substitute value for active power limitation outside of normal feed-in operation during communication disturbance	0 kW to 550 kW	Sunny Central 500CP XT	550 kW
		0 kW to 700 kW	Sunny Central 630CP XT	700 kW
		0 kW to 792 kW	Sunny Central 720CP XT	792 kW
		0 kW to 836 kW	Sunny Central 760CP XT	836 kW
		0 kW to 880 kW	Sunny Central 800CP XT	880 kW
		0 kW to 935 kW	Sunny Central 850CP XT	935 kW
		0 kW to 990 kW	Sunny Central 900CP XT	990 kW
		0 kW to 1,100 kW	Sunny Central 1000CP XT	1,100 kW

Name	Description	Value/range	Explanation	Default value
P-WSubValRun	Substitute value for active power limitation in normal feed-in operation during communication disturbance	0 kW to 550 kW	Sunny Central 500CP XT	550 kW
		0 kW to 700 kW	Sunny Central 630CP XT	700 kW
		0 kW to 792 kW	Sunny Central 720CP XT	792 kW
		0 kW to 836 kW	Sunny Central 760CP XT	836 kW
		0 kW to 880 kW	Sunny Central 800CP XT	880 kW
		0 kW to 935 kW	Sunny Central 850CP XT	935 kW
		0 kW to 990 kW	Sunny Central 900CP XT	990 kW
		0 kW to 1,100 kW	Sunny Central 1000CP XT	1,100 kW
Q-VArSubVal	Substitute value for reactive power setpoint outside of normal feed-in operation during communication disturbance	−245 kVAr to +245 kVAr	Sunny Central 500CP XT	0 kVAr
		−310 kVAr to +310 kVAr	Sunny Central 630CP XT	
		−346 kVAr to +346 kVAr	Sunny Central 720CP XT	
		−365 kVAr to +365 kVAr	Sunny Central 760CP XT	
		−385 kVAr to +385 kVAr	Sunny Central 800CP XT	
		−409 kVAr to +409 kVAr	Sunny Central 850CP XT	
		−433 kVAr to +433 kVAr	Sunny Central 900CP XT	
		−485 kVAr to +485 kVAr	Sunny Central 1000CP XT	
PF-PFSubVal	Substitute value for cos φ outside of normal feed-in operation during communication disturbance The lower limit is defined by the parameter **PFAbsMin**.	0.5 ... 1	–	1
PF-PFExtSubVal	Substitute value for excitation type during communication disturbance	OvExt	Overexcited	OvExt
		UnExt	Underexcited	

Name	Description	Value/range	Explanation	Default value
Q-VArSubValRun	Substitute value for reactive power setpoint in normal feed-in operation during communication disturbance	−245 kVAr to +245 kVAr	Sunny Central 500CP XT	0 kVAr
		−310 kVAr to +310 kVAr	Sunny Central 630CP XT	
		−346 kVAr to +346 kVAr	Sunny Central 720CP XT	
		−365 kVAr to +365 kVAr	Sunny Central 760CP XT	
		−385 kVAr to +385 kVAr	Sunny Central 800CP XT	
		−409 kVAr to +409 kVAr	Sunny Central 850CP XT	
		−433 kVAr to +433 kVAr	Sunny Central 900CP XT	
		−485 kVAr to +485 kVAr	Sunny Central 1000CP XT	
Q-VLockInW**	Voltage value from which the Q(V) characteristic curve is activated, in % relative to the nominal voltage	0 % ... 100 %	–	0 %
Q-VLockOutW**	Voltage value from which the Q(V) characteristic curve is deactivated, in % based on the nominal voltage	0 % ... 100 %	–	0 %
Q-VLockInTm**	Waiting time for activation of the Q(V) characteristic curve	0 s to 100 s	–	2 s
Q-VLockOutTm**	Waiting time for deactivation of the Q(V) characteristic curve	0 s to 100 s	–	2 s

Name	Description	Value/range	Explanation	Default value
Q-VArGraNomPos**	Reactive power gradient at a positive change of nominal voltage	0%/V to 40.06%/V	Sunny Central 500CP XT	0%/V
		0%/V to 31.47%/V	Sunny Central 630CP XT	
		0%/V to 27.82%/V	Sunny Central 720CP XT	
		0%/V to 26.35%/V	Sunny Central 760CP XT	
		0%/V to 25.04%/V	Sunny Central 800CP XT	
		0%/V to 23.56%/V	Sunny Central 850CP XT	
		0%/V to 22.25%/V	Sunny Central 900CP XT	
		0%/V to 22.25%/V	Sunny Central 1000CP XT	
Q-VArGraNomNeg**	Reactive power gradient at a negative change of nominal voltage	0%/V to 40.06%/V	Sunny Central 500CP XT	0%/V
		0%/V to 31.47%/V	Sunny Central 630CP XT	
		0%/V to 27.82%/V	Sunny Central 720CP XT	
		0%/V to 26.35%/V	Sunny Central 760CP XT	
		0%/V to 25.04%/V	Sunny Central 800CP XT	
		0%/V to 23.56%/V	Sunny Central 850CP XT	
		0%/V to 22.25%/V	Sunny Central 900CP XT	
		0%/V to 22.25%/V	Sunny Central 1000CP XT	
PF-PFSubValRun	Substitute value cos φ in normal feed-in operation during communication disturbance The lower limit is defined by the parameter **PFAbsMin**.	0.5 ... 1	–	1
PF-PFExtSubValR	Substitute value of the excitation type in normal feed-in operation during communication disturbance	OvExt	Overexcited	OvExt
		UnExt	Underexcited	
PwrMonErrMod	Mode used in the event of communication disturbance	LastVal	Use of last default values received	LastVal
		SubVal	Use of substitute values	
PwrMonErrTm	Communication downtime until substitute values are used	1 s to 999 s	–	300 s

Name	Description	Value/range	Explanation	Default value
QoDEna	Activates/deactivates the function "Q at Night"	Off	"Q at Night" function disabled	Off
		On	"Q at Night" function enabled	
QoDDccOffDelay*	Delay time until the DC switchgear opens in the operating state "Q at Night"	0 s to 86,400 s	–	3,600 s

* You can only view this parameter.
** To change this parameter, you must enter the installer password.
*** To view or change this parameter, you must enter the installer password.

14.2.1.2 Grid Monitoring and Grid Limits

To change these parameters, you must enter the installer password.

Name	Description	Range	Explanation	Default value
VRtg	Nominal line-to-line voltage of the utility grid	1 V to 70,000 V	–	20,000 V
VCtlMax	Threshold for overvoltage release level 3	100 % ... 150 %	–	Country-specific
VCtlMaxTm	Delay time for overvoltage level 3	0 ms - to 1,000,000 ms	–	Country-specific
VCtlhhLim	Threshold for overvoltage release level 2	100 % ... 150 %	–	Country-specific
VCtlhhLimTm	Delay time for overvoltage level 2	0 ms - to 1,000,000 ms	–	Country-specific
VCtlhLim	Threshold for overvoltage release level 1	100 % ... 150 %	–	Country-specific
VCtlhLimTm	Delay time for overvoltage level 1	0 ms - to 1,000,000 ms	–	Country-specific
VCtllLim	Threshold for undervoltage release level 1	0 % ... 100 %	–	Country-specific
VCtllLimTm	Delay time for undervoltage level 1	0 ms - to 1,000,000 ms	–	Country-specific
VCtlllLim	Threshold for undervoltage release level 2	0 % ... 100 %	–	Country-specific
VCtlllLimTm	Delay time for undervoltage level 2	0 ms - to 1,000,000 ms	–	Country-specific
VCtlMin	Threshold for undervoltage release level 3	0 % ... 100 %	–	Country-specific
VCtlMinTm	Delay time for undervoltage level 3	0 ms - to 1,000,000 ms	–	Country-specific

Name	Description	Range	Explanation	Default value
VCtllCharEna	Activation of dynamic undervoltage detection	Off	Deactivated	Country-specific
		On	Activated	
VCtllCharTm	Start time of dynamic undervoltage detection	0 ms to 1,000,000 ms	–	77 ms
VCtlOpMinNom	Minimum connection voltage	0 % ... 100 %	–	Country-specific
VCtlOpMaxNom	Maximum connection voltage	100 % ... 200 %	–	Country-specific
HzCtlOpMin	Minimum connection frequency	Country-specific	–	Country-specific
HzCtlOpMax	Maximum connection frequency	Country-specific	–	Country-specific
HzCtlOpMaxRecon	Maximum connection frequency after grid error	Country-specific	–	Country-specific
HzCtlMax	Threshold for overfrequency level 3	Country-specific	–	Country-specific
HzCtlMaxTm	Delay time for overfrequency level 3	0 ms to 1,000,000 ms	–	Country-specific
HzCtlhhLim	Threshold for overfrequency level 2	Country-specific	–	Country-specific
HzCtlhhLimTm	Delay time for overfrequency level 2	0 ms - to 1,000,000 ms	–	Country-specific
HzCtlhLim	Threshold for overfrequency level 1	Country-specific	–	Country-specific
HzCtlhLimTm	Delay time for overfrequency level 1	0 ms - to 1,000,000 ms	–	Country-specific
HzCtllLim	Threshold for underfrequency level 1	Country-specific	–	Country-specific
HzCtllLimTm	Delay time for underfrequency level 1	0 ms - to 1,000,000 ms	–	Country-specific
HzCtlllLim	Threshold for underfrequency level 2	Country-specific	–	Country-specific
HzCtlllLimTm	Delay time for underfrequency level 2	0 ms - to 1,000,000 ms	–	Country-specific
HzCtlMin	Threshold for underfrequency level 3	Country-specific	–	Country-specific
HzCtlMinTm	Delay time for underfrequency level 3	0 ms - to 1,000,000 ms	–	Country-specific

Name	Description	Range	Explanation	Default value
NormVac*	Measuring range end value of AC voltage measurement	1 V to 1,000 V	–	862 V
NormAac*	Measuring range end value of AC current measurement	1 A to 3,000 A	Sunny Central 500CP XT ... Sunny Central 900CP XT	2,958 A
		1 A to 3,500 A	Sunny Central 1000CP XT	
ManResOvrVol	Manual activation after overvoltage	Off	Deactivated	Off
		On	Activated	
ManResUndrVol	Manual activation after undervoltage	Off	Deactivated	Off
		On	Activated	
ManResOvrFrq	Manual activation after overfrequency	Off	Deactivated	Off
		On	Activated	
ManResUndrFrq	Manual activation after underfrequency	Off	Deactivated	Off
		On	Activated	
ManResPID	Manual activation after interruption by passive islanding detection	Off	Deactivated	Off
		On	Activated	
ManResPLD	Manual activation after interruption due to disturbance in a line conductor	Off	Deactivated	Off
		On	Activated	

* You can only view this parameter.

14.2.1.3 Grid Support

Name	Description	Value/range	Explanation	Default value
FRTMod*	Dynamic grid support operating modes	FRT_BDEW	Complete dynamic grid support	Country-specific
		FRT_Partial	Limited dynamic grid support	
		FRT_SDLWindV	Complete dynamic grid support with FRT characteristic curve	
		FRT_Off	Deactivation of dynamic grid support	
FRTSwOffTm*	Deactivation delay of the LVRT	0 ms to 10,000 ms	–	Country-specific
FRTArGraNom**	Scaling of the K factor for LVRT	0 ... 10	Values up to max. 2 are recommended. Values larger than 2 can lead to unstable plant behavior.	Country-specific

Name	Description	Value/range	Explanation	Default value
FRTDbVolNomMax*	Upper limit of the voltage deadband	0 % ... 100 %	–	Country-specific
FRTDbVolNomMin*	Lower limit of the voltage deadband	−100 % ... 0 %	–	Country-specific
FRT2ArGraNomHi**	Gradient of the FRT characteristic curve in the event of overvoltage in the operating mode FRT_SDLWindV	0 ... 10	Values up to max. 2 are recommended. Values larger than 2 can lead to unstable plant behavior.	Country-specific
FRT2ArGraNomLo**	Gradient of the FRT characteristic curve in the event of undervoltage in the operating mode FRT_SDLWindV	0 ... 10	Values up to max. 2 are recommended. Values larger than 2 can lead to unstable plant behavior.	Country-specific
EnaAid	Activation of islanding detection	Off	Deactivated	Off
		On	Activated	
TrfVolExlHi*	Line-to-line voltage on overvoltage side of external transformer	1 V to 70,000 V	–	20,000 V
TrfVolExlLo*	Line-to-line voltage on undervoltage side of external transformer	1 V to 500 V	Sunny Central 500CP XT	270 V
			Sunny Central 630CP XT	315 V
			Sunny Central 720CP XT	324 V
			Sunny Central 760CP XT	342 V
			Sunny Central 800CP XT	360 V
			Sunny Central 850CP XT	386 V
			Sunny Central 900CP XT	405 V
			Sunny Central 1000CP XT	405 V

* To change this parameter, you must enter the installer password.
** To view or change this parameter, you must enter the installer password.

14.2.1.4 Insulation monitoring

Name	Description	Value/range	Explanation	Default value
IsoMod	Hardware selection for insulation monitoring and ground-fault monitoring	–	No insulation monitoring and ground-fault monitoring	–
		Gfdi	GFDI	
		RemGdfi	Remote GFDI	
		IsoMeas	Insulation monitoring	
		IsoMeasGfdi	Insulation monitoring with GFDI	
		IsoMeasRemGfdi	Insulation monitoring with Remote GFDI	
		SoftGndDold	Soft Grounding	
		IsoMeasSoftGndD	Insulation monitoring with Soft Grounding	
		USRemGFDI	Remote GFDI for the U.S.	
		AutoUSRemGFDI	Automatic Remote GFDI for the U.S.	
IsoErrIgn*	Ignore insulation error	Off	Deactivated	Off
		On	Activated	
		Run	Error is only ignored when the inverter is in feed-in operation.	
RemMntSvc	PV array grounding is deactivated.	Off	Deactivated	Off
		On	Activated	
RisoCtlWarn	Warning threshold for the insulation monitoring device iso-PV1685	0 kΩ to 500 kΩ	–	45 kΩ
PvVtgRisoStart	Start voltage of insulation measurement	0 V to 1,200 V	Sunny Central 500CP XT	250 V
			Sunny Central 630CP XT	
			Sunny Central 720CP XT	
			Sunny Central 760CP XT	
			Sunny Central 800CP XT	
			Sunny Central 850CP XT	
			Sunny Central 900CP XT	
			Sunny Central 1000CP XT	

Name	Description	Value/range	Explanation	Default value
PvVtgRisoDif	Differential voltage to **PvVtgStrLevMin** for switching from insulation measurement to feed-in operation	−250 V to +250 V	–	0 V
IsoDev*	Selection of insulation monitoring device	isoPV3	–	isoPV3
		isoPV1685	–	

* To view or change this parameter, you must enter the installer password.

14.2.1.5 Project-Specific Parameters

Name	Description	Value/range	Explanation	Default value
PvPwrMinTr	Threshold for starting the MPP tracker	0 kW to 20 kW	–	20 kW
PvPwrMinTrT	Timeout for starting the MPP tracker	1 s to 1,800 s	–	600 s
PvVtgStrLevMin*	Threshold for switching to feed-in operation	0 V to 1,200 V	Sunny Central 500CP XT	500 V
		0 V to 1,200 V	Sunny Central 630CP XT	610 V
		0 V to 1,200 V	Sunny Central 720CP XT	630 V
		0 V to 1,200 V	Sunny Central 760CP XT	660 V
		0 V to 1,200 V	Sunny Central 800CP XT	705 V
		0 V to 1,200 V	Sunny Central 850CP XT	760 V
		0 V to 1,200 V	Sunny Central 900CP XT	770 V
		0 V to 1,200 V	Sunny Central 1000CP XT	770 V
PVStrT	Once the specified time has elapsed, the inverter switches from the operating state "Grid monitoring" to the operating state "Grid monitoring time reached".	1 s to 655 s	–	90 s
VArGra**	Gradient of reactive power change	0%/s to 200%/s	–	20%/s
QoDInvCurPv***	Maximum allowed reverse current to the PV array	−1,600 A to 0 A	–	−60 A

Name	Description	Value/range	Explanation	Default value
MppFact	Ratio between maximum power P_{MPP} of the PV cell at the maximum power point and the product of open-circuit voltage V_{OC} and short-circuit current I_{SC}	0.5 ... 1	–	0.8
Serial Number ***	Inverter serial number	0 ... 2147483647	–	0
CntrySet*	Selection of country settings	Country-specific	Parameter can only be changed in the operating state "Stop".	Country-specific
CardFunc*	MMC/SD memory card function	ForcedWrite	Eject SD memory card	0
		StoFailStt	Write fault memory to SD memory card	
DtSet	Date	20060101 ... 20991231	yyyymmdd	0
TmSet	Time	0 ... 235959	hhmmss	0
TmZn	Time zone	GMT –12:00 to GMT 12:00	Configurable time zones	Country-specific
ExtSolIrrOfs	Offset of the external irradiation sensor	−5,000 ... 5,000	–	0
ExtSolIrrGain	Amplification of external irradiation sensor	−1,000 ... 1,000	–	1
CntRs*	Meter reset	h-Cnt	Operating hours meter	–
		E-Cnt	Energy meter	
		CntFanHs	All fan runtime meters	
		CntFanCab1	Run time counter of interior fan 1	
		CntFanCab2	Run time counter of interior fan 2	
		CntFanCab3	Run time counter of interior fan 3	
		CntHtCab2	Run time counter of internal heating element	
Ofs_h-On**	Offset for operating hours	0 h to 2,147,482 h	–	0 h
Ofs_h-Total**	Offset for feed-in hours	0 h to 2,147,482 h	–	0 h
Ofs_E-Total**	Offset for total supplied energy	0 kWh to 214,748,267 kWh	–	0 kWh

Name	Description	Value/range	Explanation	Default value
Ofs_CntFanHs*	Offset for operating hours of heat sink fan	0 h to 2,147,482 h	–	0 h
Ofs_CntFanCab1*	Offset for operating hours of interior fan 1	0 h to 2,147,482 h	–	0
Ofs_CntFanCab2*	Offset for operating hours of interior fan 2	0 h to 2,147,482 h	–	0
Ofs_CntFanCab3*	Offset for operating hours of interior fan 3	0 h to 2,147,482 h	–	0
Ofs_CntHtCab2*	Offset for operating hours of internal heating element 2	0 h to 2,147,482 h	–	0
SpntRemEna	Remote activation of the PV power plant	Stop	Deactivated	Run
		Run	Activated	
Ackn	Acknowledges inverter error	Ackn	Acknowledge errors	–
GdErrTm*	Grid monitoring time after grid error	0 s to 10,000 s	–	Country-specific
GdChkTm*	Grid monitoring time during system start	0 s to 10,000 s	–	Country-specific
ExlStrStpEna*	Activation of external shutdown signal/remote shutdown	Off	Deactivated	Off
		On	Activated	
ExlTrfErrEna	Activation of hermetic protection of MV transformer	Off	Deactivated	On
		On	Activated	

* To view or change this parameter, you must enter the installer password.
** To change this parameter, you must enter the installer password.
*** You can only view this parameter.

14.2.2 Sunny Central String-Monitor Controller

Name	Description	Value/range	Explanation	Default value
Serial Number	Display of serial number	–	The value cannot be changed.	–
Firmware	Firmware version of operation control unit	0 to 255	–	–
Firmware2	Firmware version of digital signal processor	0 to 255	–	–
Dt	Entry of current date	20060101 to 20991231	Entered in the format YYYYMMDD	–

Name	Description	Value/range	Explanation	Default value
Tm	Entry of current time	0 to 235959	Entered in the format HHMMSS	–
TolGr1*	Deviation of group 1 currents from mean value	5% to 100%	Parameter exists for all six groups.	13%
MoniTmGr1On*	Start time for monitoring of group 1	07:00 a.m. to 7:00 p.m.	Parameter exists for all six groups.	10:00 a.m.
MoniTmGr1Off*	End time for monitoring of group 1	07:00 a.m. to 7:00 p.m.	Parameter exists for all six groups.	3:00 p.m.
MoniTmGrAllOn*	Start time for monitoring of all groups	07:00 a.m. to 7:00 p.m.	–	10:00 a.m.
MoniTmGrAllOff*	End time for monitoring of all groups	07:00 a.m. to 7:00 p.m.	–	3:00 p.m.
MoniTmComOn*	Start time for monitoring of all groups	07:00 a.m. to 7:00 p.m.	–	10:00 a.m.
MoniTmComOff*	End time for monitoring of all groups	07:00 a.m. to 7:00 p.m.	–	3:00 p.m.
Ackn	Acknowledge errors	quit	–	–
ErrLevGr1*	Sensitivity of error detection for group 1 Parameter exists for all six groups	24 Sensitive	50 min – 10%	32 Regular
		24 Regular	50 min – 14%	
		24 Insensitive	50 min – 18%	
		32 Sensitive	35 min – 10%	
		32 Regular	35 min – 13%	
		32 Insensitive	35 min – 16%	
		64 Sensitive	15 min – 7%	
		64 Regular	15 min – 9%	
		64 Insensitive	15 min – 10%	
ComBaud*	Baud rate	1,200 baud	Parameter can only be changed in the operating state "Stop".	19,200 baud
		4,800 baud		
		9,600 baud		
		19,200 baud		
		38,400 baud		
		57,600 baud		

Name	Description	Value/range	Explanation	Default value
DevFunc*	Manages the Sunny String-Monitors	AutoDetect_SSMU	Searches for all Sunny String-Monitors and deletes previously detected Sunny String-Monitors	0
		DetectSSMU Retry	Searches for undetected Sunny String-Monitors only	
		DelAll_SSMU	Deletes all detected Sunny String-Monitors	
		Factory	Resets all parameters to default settings.	

* To change these parameters, you must enter the installer password.

14.2.3 Sunny String-Monitor

Name	Description	Value/range	Explanation	Default value
TMittelung*	Duration of averaging of current measurements	0 s to 6,000 s	–	30 s
String Anzahl*	Number of detected strings	0 to 8	–	0
SW Version	Current firmware version	1 to 40	Value cannot be changed	
SSM Identifier*	Identification number of Sunny String-Monitor	1 to 99	–	0
Group String 1 *	Assigns strings to their respective group	0 to 3	Parameter exists for all eight groups	0
Group String*	All groups	0 to 3	–	0
No.of String 1*	Number of connected strings in the respective group	1 to 4	Parameter exists for all eight groups If you wish to use this function, contact us (see Section 17, page 264).	–
No.of Strings*	All groups	1 to 4	–	–
Monitoring1 On*	Start of monitoring of strings in group 1	0:00 a.m. to 11:59 p.m.	Parameter exists for all eight groups Configure the string settings preferably via the Sunny Central String-Monitor Controller.	0
Monitoring1 Off*	End of monitoring of strings in group 1	0:00 a.m. to 11:59 p.m.	Parameter exists for all eight groups Configure the string settings preferably via the Sunny Central String-Monitor Controller.	0

Name	Description	Value/range	Explanation	Default value
Monitoring On *	Start of monitoring of strings in all groups	0:00 a.m. to 11:59 p.m.	–	0
Monitoring Off *	End of monitoring of strings in all groups	0:00 a.m. to 11:59 p.m.	–	0
Kommando**		Stop	If you wish to use this function, contact us (see Section 17, page 264).	0
		Mess		
		Offset1		
		Offset2		
		Diag		
		Reset Err.Cnt.		
		StoreCalibData		
		LoadCalibData		
		Watchdog Test		
Surge Arrester1 *	Alarm contact (e.g. theft protection for Sunny String-Monitor)	Activ High	Contact activated when voltage is present	0
		Activ Low	Contact activated when no voltage is present	
		Deactivated	Contact deactivated	
Surge Arrester2 *	Alarm contact	Activ High	Contact activated when voltage is present	0
		Activ Low	Contact activated when no voltage is present	
		Deactivated	Contact deactivated	

* To change these parameters, you must enter the installer password.
** These parameters are only visible after entering the installer password.

14.2.4 Zone Monitoring

Name	Description	Value/range	Explanation	Default value
DcCfg.AmpMax[1]	Maximum current of input 1	0 A to 500 A	–	0 A
DcCfg.AmpMax[2]	Maximum current of input 2	0 A to 500 A	–	0 A
DcCfg.AmpMax[3]	Maximum current of input 3	0 A to 500 A	–	0 A

Name	Description	Value/range	Explanation	Default value
DcCfg.AmpMax[4]	Maximum current of input 4	0 A to 500 A	–	0 A
DcCfg.AmpMax[5]	Maximum current of input 5	0 A to 500 A	–	0 A
DcCfg.AmpMax[6]	Maximum current of input 6	0 A to 500 A	–	0 A
DcCfg.AmpMax[7]	Maximum current of input 7	0 A to 500 A	–	0 A
DcCfg.AmpMax[8]	Maximum current of input 8	0 A to 500 A	–	0 A
MaxTol	Tolerance in percent by which the input current may deviate from the mean value	0.1 % ... 100 %	–	4.0 %
DevFunc	Device function	—	Default, no action	—
		ResetMeasuring	Restarts the algorithm. All measured value are deleted.	
		Factory	Resets all parameters to default settings	
Ackn	Acknowledge errors	—	Default, no action	—
		Quit	Acknowledgment of the present error	
AlarmEna	Activation of the error analysis	—	Default, no action	—
		Off	No error analysis. Only measured value are sent.	
		On	Error analysis activated. Error messages are generated, if deviations occur (see Section 14.1.4.2, page 218).	

15 Technical Data

15.1 MV Power Station 500SC

DC Input	
MPP voltage range at +25 C	449 V to 850 V
MPP voltage range at +50°C	430 V to 850 V
Maximum input current	1,250 A
Number of independent MPP inputs	1
Number of DC inputs	9
AC Output	
AC power at +25°C**	550 kVA
AC power at +40°C**	520 kVA
AC power at +50°C**	500 kVA
Nominal AC voltage	20 kV
Optional nominal voltages	6.6 kV to 35 kV
AC power frequency	50 Hz / 60 Hz
Maximum total harmonic distortion	< 3 %
Maximum output current at 20 kV	16 A
Transformer vector groups	Dy11 / YNd11
Displacement power factor cos φ	0.9 overexcited to 0.9 underexcited
Efficiency	
Maximum efficiency	97.4 %
European weighted efficiency	97.2 %
General Data	
Width x height x depth	6,058 mm x 2,591 mm x 2,438 mm
Weight	< 10 t
Operating temperature range	−25°C to +40°C / −25°C to +55°C*
Self-consumption in operation**	< 1,950 W
Standby consumption***	< 100 W + 510 W
Internal auxiliary supply voltage	230 V / 400 V (3/N/PE), 50 Hz / 60 Hz
Maximum permissible value for relative humidity (non-condensing)	15% to 95%

General Data	
Maximum operating altitude above mean sea level	1,000 m
Maximum operating altitude above MSL for option "Installation at high altitudes"	1,001 m to 2,000 m / 2,001 m to 3,000 m
Fresh air consumption**	3,000 m³/h
Degree of protection of medium-voltage compartment as per IEC 60529	IP23D
Degree of protection of transformer compartment and inverter compartment as per IEC 60529	IP00

* optional
** information based on inverter
*** separated according to consumption of the inverter and standby power losses of the transformer

15.2 MV Power Station 630SC

DC Input	
MPP voltage range at +25 C	529 V to 850 V
MPP voltage range at +50°C	500 V to 850 V
Maximum input current	1,350 A
Number of independent MPP inputs	1
Number of DC inputs	9

AC Output	
AC power at +25°C**	700 kVA
AC power at +40°C**	655 kVA
AC power at +50°C**	630 kVA
Nominal AC voltage	20 kV
Optional nominal voltages	6.6 kV to 35 kV
AC power frequency	50 Hz / 60 Hz
Maximum total harmonic distortion	< 3 %
Maximum output current at 20 kV	21 A
Transformer vector groups	Dy11 / YNd11
Displacement power factor cos φ	0.9 overexcited to 0.9 underexcited

Efficiency	
Maximum efficiency	97.5 %
European weighted efficiency	97.3 %

General Data	
Width x height x depth	6,058 mm x 2,591 mm x 2,438 mm
Weight	< 10 t
Operating temperature range	−25°C to +40°C / −25°C to +55°C*
Self-consumption in operation**	< 1,950 W
Standby consumption***	< 100 W + 600 W
Internal auxiliary supply voltage	230 V / 400 V (3/N/PE), 50 Hz / 60 Hz
Maximum permissible value for relative humidity (non-condensing)	15% to 95%
Maximum operating altitude above mean sea level	1,000 m
Maximum operating altitude above MSL for option "Installation at high altitudes"	1,001 m to 2,000 m / 2,001 m to 3,000 m
Fresh air consumption**	3,000 m³/h
Degree of protection of medium-voltage compartment as per IEC 60529	IP23D
Degree of protection of transformer compartment and inverter compartment as per IEC 60529	IP00

* optional
** information based on inverter
*** separated according to consumption of the inverter and standby power losses of the transformer

15.3 MV Power Station 800SC

DC Input	
MPP voltage range at +25 C	641 V to 850 V
MPP voltage range at +50°C	583 V to 850 V
Maximum input current	1,400 A
Number of independent MPP inputs	1
Number of DC inputs	9

AC Output	
AC power at +25°C**	880 kVA
AC power at +40°C**	832 kVA
AC power at +50°C**	800 kVA
Nominal AC voltage	20 kV
Optional nominal voltages	6.6 kV to 35 kV
AC power frequency	50 Hz / 60 Hz

AC Output	
Maximum total harmonic distortion	< 3 %
Maximum output current at 20 kV	26 A
Transformer vector groups	Dy11 / YNd11
Displacement power factor cos φ	0.9 overexcited to 0.9 underexcited
Efficiency	
Maximum efficiency	97.4 %
European weighted efficiency	97.2 %
General Data	
Width x height x depth	6,058 mm x 2,591 mm x 2,438 mm
Weight	< 10 t
Operating temperature range	−25°C to +40°C / −25°C to +55°C*
Self-consumption in operation**	< 1,950 W
Standby consumption***	< 100 W + 650 W
Internal auxiliary supply voltage	230 V / 400 V (3/N/PE), 50 Hz / 60 Hz
Maximum permissible value for relative humidity (non-condensing)	15% to 95%
Maximum operating altitude above mean sea level	1,000 m
Maximum operating altitude above MSL for option "Installation at high altitudes"	1,001 m to 2,000 m / 2,001 m to 3,000 m
Fresh air consumption**	3,000 m³/h
Degree of protection of medium-voltage compartment as per IEC 60529	IP23D
Degree of protection of transformer compartment and inverter compartment as per IEC 60529	IP00

* optional
** information based on inverter
*** separated according to consumption of the inverter and standby power losses of the transformer

15.4 MV Power Station 900SC

DC Input	
MPP voltage range at +25 C	722 V to 850 V
MPP voltage range at +50°C	656 V to 850 V
Maximum input current	1,400 A

DC Input	
Number of independent MPP inputs	1
Number of DC inputs	9
AC Output	
AC power at +25°C**	990 kVA
AC power at +40°C**	936 kVA
AC power at +50°C**	900 kVA
Nominal AC voltage	20 kV
Optional nominal voltages	6.6 kV to 35 kV
AC power frequency	50 Hz / 60 Hz
Maximum total harmonic distortion	< 3 %
Maximum output current at 20 kV	29 A
Transformer vector groups	Dy11 / YNd11
Displacement power factor cos φ	0.9 overexcited to 0.9 underexcited
Efficiency	
Maximum efficiency	97.4 %
European weighted efficiency	97.2 %
General Data	
Width x height x depth	6,058 mm x 2,591 mm x 2,438 mm
Weight	< 10 t
Operating temperature range	−25°C to +40°C / −25°C to +55°C*
Self-consumption in operation**	< 1,950 W
Standby consumption***	< 100 W + 710 W
Internal auxiliary supply voltage	230 V / 400 V (3/N/PE), 50 Hz / 60 Hz
Maximum permissible value for relative humidity (non-condensing)	15% to 95%
Maximum operating altitude above mean sea level	1,000 m
Maximum operating altitude above MSL for option "Installation at high altitudes"	1,001 m to 2,000 m / 2,001 m to 3,000 m
Fresh air consumption**	3,000 m³/h

General Data	
Degree of protection of medium-voltage compartment as per IEC 60529	IP23D
Degree of protection of transformer compartment and inverter compartment as per IEC 60529	IP00

* optional
** information based on inverter
*** separated according to consumption of the inverter and standby power losses of the transformer

15.5 MV Power Station 1000-1SC

DC Input	
MPP voltage range at +25 C	688 V to 850 V
MPP voltage range at +50°C	596 V to 850 V
Maximum input current	1,635 A
Number of independent MPP inputs	1
Number of DC inputs	9

AC Output	
AC power at +25°C**	1,100 kVA
AC power at +40°C**	1,000 kVA
AC power at +50°C**	900 kVA
Nominal AC voltage	20 kV
Optional nominal voltages	6.6 kV to 35 kV
AC power frequency	50 Hz / 60 Hz
Maximum total harmonic distortion	< 3 %
Maximum output current at 20 kV	32 A
Transformer vector groups	Dy11 / YNd11
Displacement power factor cos φ	0.9 overexcited to 0.9 underexcited

Efficiency	
Maximum efficiency	97.5 %
European weighted efficiency	97.2 %

General Data	
Width x height x depth	6,058 mm x 2,591 mm x 2,438 mm
Weight	< 10 t
Operating temperature range	−25°C to +40°C / −25°C to +55°C*

General Data	
Self-consumption in operation**	< 1900 W
Standby consumption***	< 100 W + 770 W
Internal auxiliary supply voltage	230 V / 400 V (3/N/PE), 50 Hz / 60 Hz
Maximum permissible value for relative humidity (non-condensing)	15% to 95%
Maximum operating altitude above mean sea level	1,000 m
Maximum operating altitude above MSL for option "Installation at high altitudes"	1,001 m to 2,000 m / 2,001 m to 3,000 m
Fresh air consumption**	6,000 m^3/h
Degree of protection of medium-voltage compartment as per IEC 60529	IP23D
Degree of protection of transformer compartment and inverter compartment as per IEC 60529	IP00

* optional
** information based on inverter
*** separated according to consumption of the inverter and standby power losses of the transformer

15.6 MV Power Station 1000-2SC

DC Input	
MPP voltage range at +25 C	449 V to 850 V
MPP voltage range at +50°C	430 V to 850 V
Maximum input current	2 x 1,250 A
Number of independent MPP inputs	2
Number of DC inputs	18

AC Output	
AC power at +25°C**	1,100 kVA
AC power at +40°C**	1,040 kVA
AC power at +50°C**	1,000 kVA
Nominal AC voltage	20 kV
Optional nominal voltages	6.6 kV to 35 kV
AC power frequency	50 Hz / 60 Hz
Maximum total harmonic distortion	< 3 %
Maximum output current at 20 kV	32 A

AC Output	
Transformer vector groups	Dy11y11 / YNd11d11
Displacement power factor cos φ	0.9 overexcited to 0.9 underexcited

Efficiency	
Maximum efficiency	97.6 %
European weighted efficiency	97.4 %

General Data	
Width x height x depth	6,058 mm x 2,591 mm x 2,438 mm
Weight	< 14 t
Operating temperature range	−25°C to +40°C / −25°C to +55°C*
Self-consumption in operation**	< 3,800 W
Standby consumption***	< 200 W + 770 W
Internal auxiliary supply voltage	230 V / 400 V (3/N/PE), 50 Hz / 60 Hz
Maximum permissible value for relative humidity (non-condensing)	15% to 95%
Maximum operating altitude above mean sea level	1,000 m
Maximum operating altitude above MSL for option "Installation at high altitudes"	1,001 m to 2,000 m / 2,001 m to 3,000 m
Fresh air consumption**	6,000 m^3/h
Degree of protection of medium-voltage compartment as per IEC 60529	IP23D
Degree of protection of transformer compartment and inverter compartment as per IEC 60529	IP00

* optional
** information based on inverter
*** separated according to consumption of the inverter and standby power losses of the transformer

15.7 MV Power Station 1250SC

DC Input	
MPP voltage range at +25 C	529 V to 850 V
MPP voltage range at +50°C	500 V to 850 V
Maximum input current	2 x 1,350 A
Number of independent MPP inputs	2
Number of DC inputs	18

AC Output	
AC power at +25°C**	1,375 kVA
AC power at +40°C**	1,300 kVA
AC power at +50°C**	1,250 kVA
Nominal AC voltage	20 kV
Optional nominal voltages	6.6 kV to 35 kV
AC power frequency	50 Hz / 60 Hz
Maximum total harmonic distortion	< 3 %
Maximum output current at 20 kV	40 A
Transformer vector groups	Dy11y11 / YNd11d11
Displacement power factor cos φ	0.9 overexcited to 0.9 underexcited
Efficiency	
Maximum efficiency	97.7 %
European weighted efficiency	97.5 %
General Data	
Width x height x depth	6,058 mm x 2,591 mm x 2,438 mm
Weight	< 14 t
Operating temperature range	−25°C to +40°C / −25°C to +55°C*
Self-consumption in operation**	< 3,800 W
Standby consumption***	< 200 W + 950 W
Internal auxiliary supply voltage	230 V / 400 V (3/N/PE), 50 Hz / 60 Hz
Maximum permissible value for relative humidity (non-condensing)	15% to 95%
Maximum operating altitude above mean sea level	1,000 m
Maximum operating altitude above MSL for option "Installation at high altitudes"	1,001 m to 2,000 m / 2,001 m to 3,000 m
Fresh air consumption**	6,000 m^3/h
Degree of protection of medium-voltage compartment as per IEC 60529	IP23D
Degree of protection of transformer compartment and inverter compartment as per IEC 60529	IP00

* optional
** information based on inverter
*** separated according to consumption of the inverter and standby power losses of the transformer

15.8 MV Power Station 1600SC

DC Input	
MPP voltage range at +25 C	641 V to 850 V
MPP voltage range at +50°C	583 V to 850 V
Maximum input current	2 x 1,400 A
Number of independent MPP inputs	2
Number of DC inputs	18
AC Output	
AC power at +25°C**	1,760 kVA
AC power at +40°C**	1,664 kVA
AC power at +50°C**	1,600 kVA
Nominal AC voltage	20 kV
Optional nominal voltages	6.6 kV to 35 kV
AC power frequency	50 Hz / 60 Hz
Maximum total harmonic distortion	< 3 %
Maximum output current at 20 kV	51 A
Transformer vector groups	Dy11y11 / YNd11d11
Displacement power factor cos φ	0.9 overexcited to 0.9 underexcited
Efficiency	
Maximum efficiency	97.6 %
European weighted efficiency	97.4 %
General Data	
Width x height x depth	6,058 mm x 2,591 mm x 2,438 mm
Weight	< 14 t
Operating temperature range	−25°C to +40°C / −25°C to +55°C*
Self-consumption in operation**	< 3,800 W
Standby consumption***	< 200 W + 1,200 W
Internal auxiliary supply voltage	230 V / 400 V (3/N/PE), 50 Hz / 60 Hz
Maximum permissible value for relative humidity (non-condensing)	15% to 95%
Maximum operating altitude above mean sea level	1,000 m

General Data	
Maximum operating altitude above MSL for option "Installation at high altitudes"	1,001 m to 2,000 m / 2,001 m to 3,000 m
Fresh air consumption**	6,000 m^3/h
Degree of protection of medium-voltage compartment as per IEC 60529	IP23D
Degree of protection of transformer compartment and inverter compartment as per IEC 60529	IP00

* optional
** information based on inverter
*** separated according to consumption of the inverter and standby power losses of the transformer

15.9 MV Power Station 1800SC

DC Input	
MPP voltage range at +25 C	722 V to 850 V
MPP voltage range at +50°C	656 V to 850 V
Maximum input current	2 x 1,400 A
Number of independent MPP inputs	2
Number of DC inputs	18

AC Output	
AC power at +25°C**	1,980 kVA
AC power at +40°C**	1,872 kVA
AC power at +50°C**	1,800 kVA
Nominal AC voltage	20 kV
Optional nominal voltages	6.6 kV to 35 kV
AC power frequency	50 Hz / 60 Hz
Maximum total harmonic distortion	< 3 %
Maximum output current at 20 kV	58 A
Transformer vector groups	Dy11y11 / YNd11d11
Displacement power factor cos φ	0.9 overexcited to 0.9 underexcited

Efficiency	
Maximum efficiency	97.6 %
European weighted efficiency	97.4 %

General Data	
Width x height x depth	6,058 mm x 2,591 mm x 2,438 mm
Weight	< 14 t
Operating temperature range	−25°C to +40°C / −25°C to +55°C*
Self-consumption in operation**	< 3,800 W
Standby consumption***	< 200 W + 1,350 W
Internal auxiliary supply voltage	230 V / 400 V (3/N/PE), 50 Hz / 60 Hz
Maximum permissible value for relative humidity (non-condensing)	15% to 95%
Maximum operating altitude above mean sea level	1,000 m
Maximum operating altitude above MSL for option "Installation at high altitudes"	1,001 m to 2,000 m / 2,001 m to 3,000 m
Fresh air consumption**	6,000 m^3/h
Degree of protection of medium-voltage compartment as per IEC 60529	IP23D
Degree of protection of transformer compartment and inverter compartment as per IEC 60529	IP00

* optional
** information based on inverter
*** separated according to consumption of the inverter and standby power losses of the transformer

15.10 MV Power Station 2000SC

DC Input	
MPP voltage range at +25 C	688 V to 850 V
MPP voltage range at +50°C	596 V to 850 V
Maximum input current	2 x 1,635 A
Number of independent MPP inputs	2
Number of DC inputs	18

AC Output	
AC power at +25°C**	2,200 kVA
AC power at +40°C**	2,000 kVA
AC power at +50°C**	1,800 kVA
Nominal AC voltage	20 kV
Optional nominal voltages	6.6 kV to 35 kV
AC power frequency	50 Hz / 60 Hz

AC Output	
Maximum total harmonic distortion	< 3 %
Maximum output current at 20 kV	64 A
Transformer vector groups	Dy11y11 / YNd11d11
Displacement power factor cos φ	0.9 overexcited to 0.9 underexcited
Efficiency	
Maximum efficiency	97.7 %
European weighted efficiency	97.4 %
General Data	
Width x height x depth	6,058 mm x 2,591 mm x 2,438 mm
Weight	< 14 t
Operating temperature range	−25°C to +40°C / −25°C to +55°C*
Self-consumption in operation**	< 3,800 W
Standby consumption***	< 200 W + 1,450 W
Internal auxiliary supply voltage	230 V / 400 V (3/N/PE), 50 Hz / 60 Hz
Maximum permissible value for relative humidity (non-condensing)	15% to 95%
Maximum operating altitude above mean sea level	1,000 m
Maximum operating altitude above MSL for option "Installation at high altitudes"	1,001 m to 2,000 m / 2,001 m to 3,000 m
Fresh air consumption**	6,000 m^3/h
Degree of protection of medium-voltage compartment as per IEC 60529	IP23D
Degree of protection of transformer compartment and inverter compartment as per IEC 60529	IP00

* optional
** information based on inverter
*** separated according to consumption of the inverter and standby power losses of the transformer

16 Appendix

16.1 Scope of Delivery

Check the scope of delivery for completeness and any externally visible damage. Contact your distributor if the scope of delivery is incomplete or damaged.

Scope of delivery of the station container

The scope of delivery of the station container is located in the compartment of the medium-voltage switchgear.

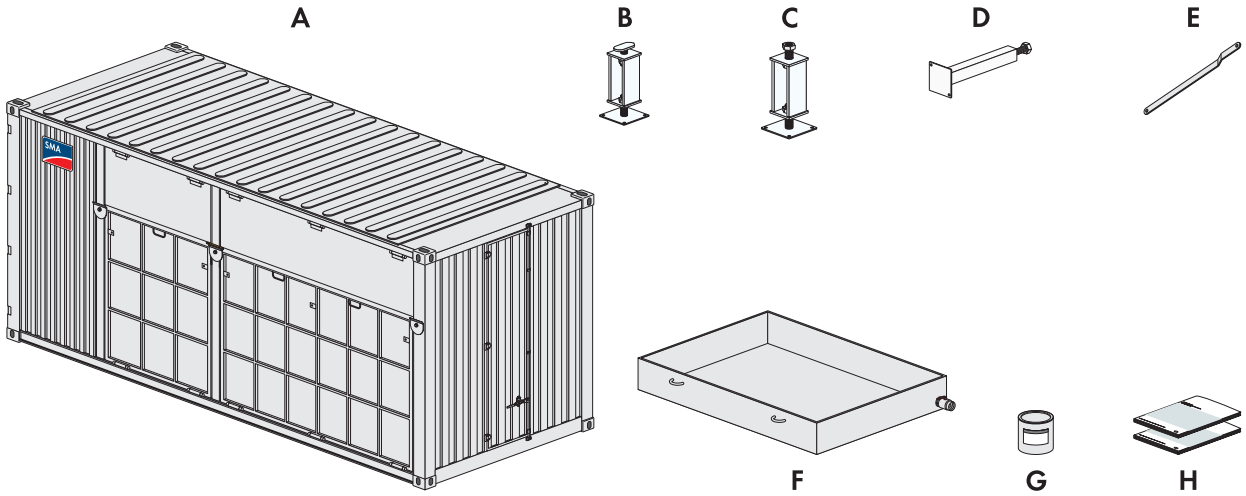


Figure 88: Scope of delivery of the station container

Position	Quantity	Designation
A	1	MV Power Station
B	4	Support foot for the container corners
C	2	Support foot for the container sides
D	10	Support foot for the service platform
E	8	Protective roof bracket
F	1	Oil tray with oil drain valve*
G	1	Spare paint
H	1	Documentation, circuit diagram

* Optional Depending on the production version, the oil drain valve is mounted or not.

Scope of Delivery of the Medium-Voltage Switchgear

The scope of delivery of the medium-voltage switchgear is located in the compartment of the medium-voltage switchgear.

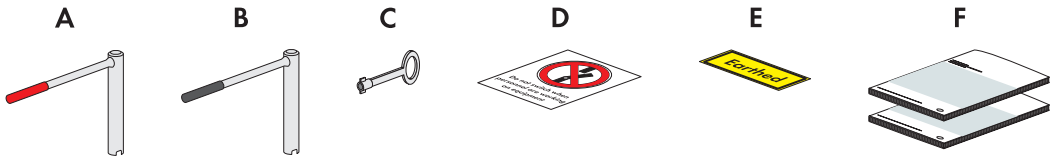


Figure 89: Scope of delivery of the medium-voltage switchgear

Position	Quantity	Designation
A	1	Actuation lever for grounding switch
B	1	Actuation lever for disconnection unit, load-break switch and circuit breaker
C	1	Double-bit key for the medium-voltage switchgear
D	1	Magnetic sign "Do not switch"
E	1	Magnetic sign "Earthed"
F	1	Documentation for the medium-voltage switchgear

Additional scope of delivery for order option "Country package, France"

The additional accessories for the order option "Country package, France" are located in the compartment of the medium-voltage switchgear. The indicated number of the individual components differs from the number of mounted inverters in the MV Power Station.

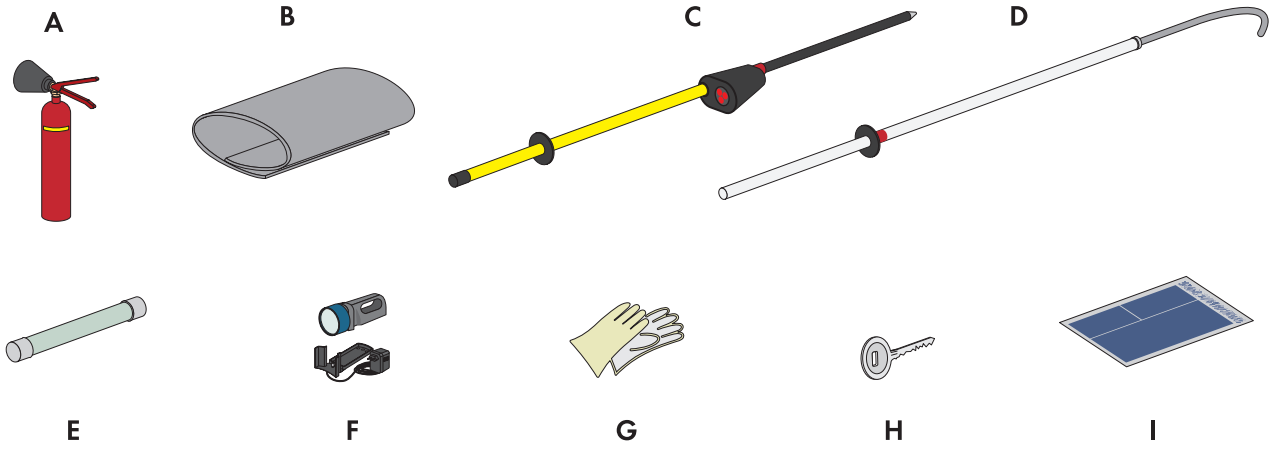


Figure 90: Scope of Delivery of the Medium-Voltage Switchgear

Position	Quantity	Designation
A	1	Fire extinguisher
B	1	Insulation mat
C	1	Voltage detector
D	1	Safety bar

Position	Quantity	Designation
E	3	Spare fuse for the medium-voltage switchgear for order option "Ring (three-field), transformer panel with fuses"
F	1	Hand lamp with rechargeable battery and charging station
G	1	Insulation gloves
H	3/4	Key for access lock for MV transformer
I	1	Safety Information

Scope of delivery of the inverter

The scope of delivery of the inverter is located in the connection area of the inverter. The indicated number of the individual components differs depending on the number of mounted inverters in the MV Power Station.

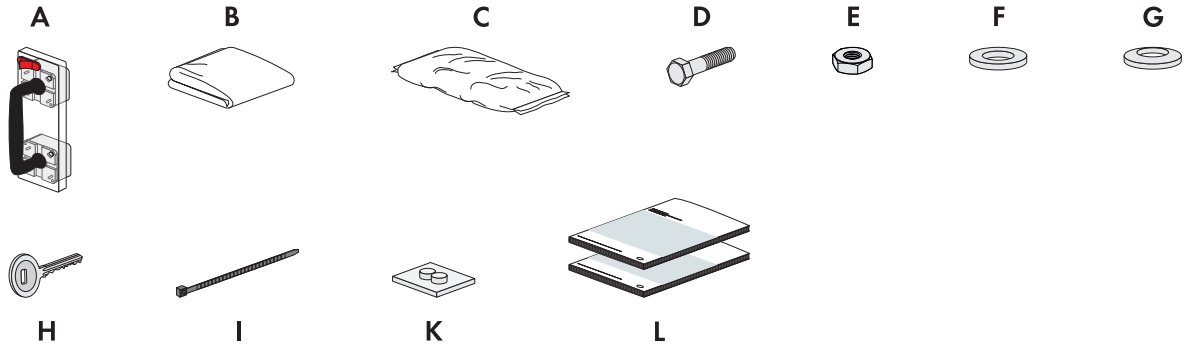


Figure 91: Scope of delivery of the inverter

Position	Quantity	Designation
A	1/2	LV/HRC fuse extractor
B	1/2	Non-woven abrasive
C	1/2	Desiccant bag
D	51/105*	Bolt
	54/108**	
E	51/105*	Nut
	54/108**	
F	102/210*	Fender washer
	108/216**	
G	102/210*	Spring washer
	108/216**	
H	1/2	Inverter key
I	80/160	Cable tie

Position	Quantity	Designation
K	3/6	Cable support sleeve
L	1	Circuit diagram

* With transformer for internal power supply
** Without transformer for internal power supply

16.2 Storage

If you need to store the inverter prior to final installation, note the following points:

NOTICE

Damage to the devices due to sand, dust or moisture penetration

Sand, dust or moisture penetration can damage the devices of the MV Power Station or impair their functionality.

- Do not open any devices during a sandstorm, precipitation or when humidity exceeds 95%.
- Only perform maintenance work when the environment is dry and free of dust.
- If the installation, maintenance or commissioning process is interrupted, mount all enclosure parts and close all doors.

NOTICE

Damage to the frame construction due to uneven support surface

If the product is set down on uneven surfaces, components may distort. This may lead to moisture and dust penetration into the components.

- Never place the product on an unstable, uneven surface; not even for a short period of time.
- The unevenness of the support surface must be less than 0.25%.
- The support surface must be suitable for the weight of the product.
- Prior to storage, ensure that the doors of the product are tightly closed.

Desiccant bag in the inverter cabinet

The desiccant bag in the inverter cabinet protects the electronic components from moisture. The desiccant bag must be replaced by a new desiccant bag included in the scope of delivery one day before commissioning.

16.3 Installation Information

16.3.1 Torques

Torques of the power connections:

Type of terminal lug	Torque
Tin-plated aluminum terminal lug on copper bar	37 Nm
Tin-plated copper terminal lug on copper bar	60 Nm
Tin-plated aluminum or copper terminal lug on aluminum bar	37 Nm

Torques at panels, covers and grounding conductor:

Position	Torque
Grounding conductors on the kick plates	8 Nm to 10 Nm

Position	Torque
Mounting the kick plates	2 Nm to 3 Nm
Grounding conductor on the roof	14.2 Nm
Mounting the ventilation grids on the roof	20 Nm
Protective covers	5 Nm

16.3.2 Reduction of DC Input Currents for DC Fuses

The DC inputs are fused with LV/HRC fuses. Thermal stress and alternating loads result in reduction factors which must be taken into account when designing the DC cables.

The reduction factor 0.70 is applicable for regions where maximum ambient temperatures of 40°C are expected. If higher ambient temperatures are expected, a reduction factor of 0.64 must be used.

Fusing	Maximum DC short-circuit current I_{SC_STC} (reduction factor 0.64 at ambient temperatures exceeding 40°C)	Maximum DC short-circuit current I_{SC_STC} (reduction factor 0.70 at ambient temperatures up to and including 40°C)
125 A	80.0 A	87.5 A
160 A	102.4 A	112.0 A
200 A	128.0 A	140.0 A
250 A	160.0 A	175.0 A
315 A	201.6 A	220.5 A
400 A	256.0 A	280.0 A

When selecting the fuse size, always consider the short-circuit current of the connected PV array at standard test conditions (I_{SC_STC}).

The reduction factors apply for a maximum irradiation of 1,200 W/m² (hourly average value of the horizontal global radiation). In case the irradiation is higher, the reduction factor must be adapted linearly.

16.4 XML File custom.xml

16.4.1 Structure of the XML File custom.xml

You can upload your personal system and network settings via the XML file **custom.xml**. The communication unit checks the file to ensure that the values entered are valid and accurate, and adopts the settings upon the next reset of the communication unit.

Elements of the XML file	Explanation
<?xml version="1.0" encoding="utf-8" standalone="yes"?>	Required element of the XML file.
<WebBox xmlns:msdata="urn:schemas-microsoft-com:xml-msdata" xmlns:xsi="http://www.w3.org/2001/ XMLSchema-instance" xsi:noNamespaceSchemaLocation="config_100.xsd">	Required element of the XML file. Terminated with the tag at the end of the XML file.
<Info> <Version>**my config V1.01**</Version> </Info>	Required element of the XML file. You must enter the name and the version for your settings between the version tags. This information is displayed in the header of the user interface.

Elements of the XML file	Explanation
<Config> <Key>**NetworkSettings_DhcpUsage1**</Key> <Value>**False**</Value> </Config>	Here, you can set the parameters and their corresponding values (see Section 16.4.2, page 261).
<Loader> <Settings> <PowerFail>**2500**</PowerFail> </Settings> </Loader>	Here, you can set the time period in ms which must expire before the communication unit will shut down after the UPS of the inverter has signaled a failure of the supply voltage to the communication unit. The value must be greater than or equal to 2,500. This setting is immediately adopted once the file is uploaded.

Example: XML file for setting the Czech language on the user interface

<?xml version="1.0" encoding="utf-8" standalone="yes"?>

<WebBox xmlns:msdata="urn:schemas-microsoft-com:xml-msdata" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="config_100.xsd">

<Info>

<Version>**my config V1.01**</Version>

</Info>

<Config>

<Key>**NativeSettings_Language**</Key>

<Value>**cs**</Value>

</Config>

</WebBox>

16.4.2 Parameters and Values for the File custom.xml

Parameter	Explanation	Values	Default values
NetworkSettings_DhcpUsage1	Activates DHCP for LAN2. With the **True** value, all other settings of the IP addresses for LAN2 will be ignored.	True	False
		False	
NetworkSettings_DnsIpAddr1	Sets the first IPv4 address of the DNS server for LAN2	–	–
		0.0.0.0	
		A valid IPv4 address	
NetworkSettings_Dns2IpAddr1	Sets the second IPv4 address of the DNS server for LAN2	–	0.0.0.0
		0.0.0.0	
		A valid IPv4 address	
NetworkSettings_Gateway1	Sets the gateway address for LAN2	0.0.0.0	0.0.0.0

Parameter	Explanation	Values	Default values
NetworkSettings_IpAddr1	Sets the IPv4 address for LAN2	A valid IPv4 address	172.24.1.51
NetworkSettings_SubnetMask1	Sets the subnet mask for LAN2	255.255.0.0	255.255.0.0
NetworkSettings_DhcpUsage2	Activates DHCP for LAN3. With the **True** value, all other settings of the IP addresses for LAN3 will be ignored.	True	False
		False	
NetworkSettings_DnsIpAddr2	Sets the first IPv4 address of the DNS server for LAN3	–	–
		0.0.0.0	
		A valid IPv4 address	
NetworkSettings_Dns2IpAddr2	Sets the second IPv4 address of the DNS server for LAN3	–	0.0.0.0
		0.0.0.0	
		A valid IPv4 address	
NetworkSettings_Gateway2	Sets the gateway address for LAN3	0.0.0.0	0.0.0.0
NetworkSettings_IpAddr2	Sets the IPv4 address for LAN3	A valid IPv4 address	172.16.1.51
NetworkSettings_SubnetMask2	Sets the subnet mask for LAN3	255.255.0.0	255.255.0.0
NetworkSettings_ModbusPort	Sets the Modbus port. Do not use the following ports: 21 / 23 / 8081 / 30100	–	502
NetworkSettings_ModbusUsage	Activates use of the Modbus protocol	True	True
		False	
NetworkSettings_WebserverPort	Sets port of the web server. Do not use the following ports: 21 / 23 / 502 / 8081 / 30100	–	80

Parameter	Explanation	Values	Default values
NativeSettings_Language	Sets the language of the user interface:		en
	English	en	
	Czech	cs	
	German	de	
	Greek	el	
	Spanish	es	
	French	fr	
	Italian	it	
	Korean	ko	
	Dutch	nl	
	Portuguese	pt	
Security_InstallerPassword	Sets the installer password	–	sma

17 Contact

If you have technical problems with our products, please contact the SMA Service Line. We need the following information in order to provide you with the necessary assistance:

- Device type
- Serial number
- Type and number of PV modules connected
- Type of communication
- Error number and error message

Danmark Deutschland Österreich Schweiz	SMA Solar Technology AG Niestetal SMA Online Service Center: www.SMA.de/Service Sunny Boy, Sunny Mini Central, Sunny Tripower: +49 561 9522-1499 Monitoring Systems (Kommunikation-sprodukte): +49 561 9522-2499 Fuel Save Controller (PV-Diesel-Hybridsysteme): +49 561 9522-3199 Sunny Island, Sunny Backup, Hydro Boy: +49 561 9522-399 Sunny Central: +49 561 9522-299	Belgien Belgique België Luxemburg Luxembourg Nederland	SMA Benelux BVBA/SPRL Mechelen +32 15 286 730
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España Portugal	SMA Ibérica Tecnología Solar, S.L.U. Barcelona +34 935 63 50 99	United Kingdom	SMA Solar UK Ltd. Milton Keynes +44 1908 304899
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